

ACOUSTICS

BULLETIN



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plus... **Towards virtual sound aircraft simulation**

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ACOUSTICS

BULLETIN

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the United Kingdom concerned with acoustics. The present membership is in excess of two thousand and since 1977 it has been a fully professional institute. The Institute has representation in many major research, educational, planning and industrial establishments covering all aspects of acoustics including aerodynamic noise, environmental, industrial and architectural acoustics, audiology, building acoustics, hearing, electroacoustics, infrasonics, ultrasonics, noise, physical acoustics, speech, transportation noise, underwater acoustics, and vibration. The Institute is a Registered Charity no.267026.



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Dear Members

Welcome to the first edition of the new look *Acoustics Bulletin*. *PointOne* has been awarded the production contract, following the Publications Committee's thorough review and tender process. The committee was impressed by *PointOne*'s attractive design concepts, and I hope you will like the result.

On a sad note, this issue contains Gerry McCullagh's obituary. Gerry will be sorely missed but the continuing success of the Irish Branch, which he was instrumental in establishing, will be a testament to him.

The biennial meeting of the Chairs and Secretaries of Groups and Branches was held on 10 November. There were valuable discussions on several subjects, including the involvement of young members. Responding to this, Council has approved revisions to the terms of reference to include a Young Members' Representative on each Branch and Group management committee. Council also decided to extend young member representation on Council itself, by having two Young Members' Representatives with overlapping two-year tenures to facilitate continuity.

The 2006 Spring Conference, to be held on 3 and 4 April, will focus on contributions from young members and students. As I write this letter, the conference seems likely to be one of the biggest national conferences the Institute has organised, with at least three parallel sessions over the two days. 'Futures in Acoustics: Today's research – Tomorrow's careers' will be a showcase for research and employment opportunities across the spectrum of acoustical disciplines. Exemplifying scientific research in acoustics, two of the 2006 Medal Lectures will also be presented; Dr Mike Barron will give the Rayleigh Medal Lecture and Dr Kirill Horoshenkov the Tyndall Medal Lecture.

Better engagement with our younger members is rightly one of our current themes, but it is also appropriate to acknowledge the loyal service of our older members. Council has introduced a Silver Certificate as a gesture of appreciation for members who have been in continuous corporate membership for at least twenty-five years. The first certificates should have been despatched by the time you read this, and I hope that the recipients have been pleasantly surprised by this recognition of their valued long-term support.

I have previously mentioned that the Institute would seek your views about our activities, services and strategy. Our questionnaire has now been prepared and will be accessible on the website in January. I'm sure you'll all want to participate anyway but just in case an incentive is needed, there is a draw prize! I look forward to your opinions making a contribution to the Institute's development.



Tony Jones

PRESIDENT



Citation

Dr Per V Brüel
The Peter Barnett Memorial Award 2005

It is a great honour for members of the Institute of Acoustics to have Per Brüel in their midst at our twenty-first Reproduced Sound Conference.

All of our members, young or old, have been influenced by the work of Per Brüel in one way or another. Older members will recall the beautifully engineered B&K instruments such as the Level Recorder Type 2304, whilst over the years most practitioners in acoustics will have become familiar with the range of sound level meters and other instrumentation up to the state of the art software driven sound analysers of today.

Per's prodigious output as an instrument designer took off in 1939 at the military radio laboratory where he constructed the first acoustic analyser with constant percentage bandwidth. In 1942, he moved to Sweden and started work in the building acoustics field eventually establishing the first acoustical laboratory in Sweden at Chalmers Technical University in Gothenburg, where he became Associate Professor. It was here that many of the early versions of acoustical instruments were developed such as Condenser Microphones, the Level Recorder, the Standing Wave Tube and the Tapping Machine which later became standardised by the International Standards Organisation.

Per's collaboration with Viggo Kjær started as early as 1941 and together they formed a remarkable team where Per looked after instrument development and worldwide sales whilst Viggo took care of production and financial matters. They returned to Denmark in 1947 and over the next 40 years the company Brüel and Kjær grew from small beginnings to one of the most financially sound companies in Denmark, employing over 3000 people.

As head of sales, Per travelled world-wide giving lectures and participating in acoustics congresses. He has written over 100 articles

on acoustics and holds many patents on acoustical instruments and absorbers. He is a great believer in disseminating technical information on acoustics and has organised numerous seminars and published many invaluable booklets.

Per continues to inspire us today as a very active engineer in the design of acoustic instrumentation. In recent years he has continued his work on sound level meters and has been investigating vortex detection using a 20 kHz acoustic beam.

Per Brüel's distinguished contributions to the field of acoustics have been recognised internationally through numerous honours, including the Institute of Acoustics premier award The Rayleigh Medal in 1973/4 and conferment of Honorary Fellowship in 1986.

For his outstanding and inspirational contributions to the advancement and technical excellence of electro-acoustics, The Institute of Acoustics is delighted to award the Peter Barnett Memorial Award for 2005 to Dr Per Brüel.



Citation

Bronwen Emma Bird
Award for Promoting Acoustics to the Public

Bronwen Bird is the first recipient of this award which she has won for her sustained efforts in bringing awareness of the importance of acoustics to the general public.

Bronwen graduated from the Royal Welsh College of Music in 1994 but, having also undergone a formal science education, she has been able to combine her love of music and her understanding of the fundamentals of acoustics to form the basis of her successful career.

Her early career included periods as a visiting music teacher at schools, as a presenter and coordinator at Techniquist, one of the UK's premier Science Centres, and as Regional Officer for Wales of the British Association for the Advancement of Science. In 1998 Bronwen was appointed as the "Musiquist" project manager at Techniquist. Supported by the infrastructure of Techniquist, Bronwen has been the driving force behind a small team which has developed numerous unique and innovative science exhibits and educational programmes which convey the beauty and wonder of acoustics to a general audience.

These "Musiquist" exhibits and programmes examine the acoustics and dynamics of musical instruments, sound production and propagation, the acoustics of enclosed spaces as well as the broader aspects of music and sound technologies and composition.

As a set of exhibits, "Musiquist" is undoubtedly world leading, and the educational programmes provide support to local schools up to Key Stage 4. Bronwen also devises and presents Science Shows relating to acoustics and music designed for all ages. The 35 "Musiquist" exhibits are currently on display to the 180,000 annual visitors to Techniquist and



there are plans to take them on tour throughout the whole of the UK.

Bronwen has also instigated several high-profile activities which have combined "Musiquist" and science communication with the Welsh National Opera Company and the BBC National Orchestra of Wales. In the latter's performance of "The Young Person's Guide to the Acoustics of the Orchestra", the sight of the leader playing a tune on a tea-pot strung as a "violin" will be forever emblazoned on peoples' minds. This example sums up Bronwen's approach, namely, that she has good ideas which she turns into actions which get their message across and help promote acoustics to the general public.

For her unstinting work on communicating acoustic concepts to as many people as possible, The Institute of Acoustics is delighted to present the Award for Promoting Acoustics to the Public for 2005 to Bronwen Emma Bird.

Medals & Awards

Nominations Invited for Institute of Acoustics 2006/2007 Awards

The Institute is inviting nominations for the following three medals:

IOA Engineering Medal 2006

The Institute of Acoustics Engineering Medal is the most recent of the Institute's medals. It will be awarded on a bi-annual basis to registered engineers at Chartered, Incorporated or Engineering Technician grade in recognition of their outstanding contribution in the field of acoustical engineering.

Rayleigh Medal 2007

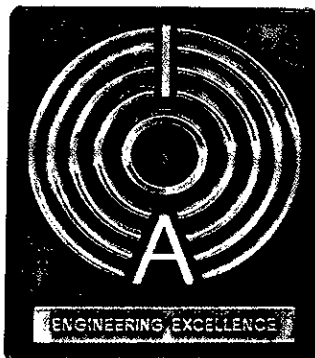
The Rayleigh Medal is the premier award, awarded without regard to age, to persons of undoubted renown for outstanding contributions to acoustics. It is normally presented to a UK acoustician in even-numbered years and an overseas acoustician in odd-numbered years. The medal is named after John William Strutt, Third Baron Rayleigh (1842-1919), a very versatile physicist who conducted both experimental and theoretical research in virtually every branch of the subject. A graduate, fellow and eventually Chancellor of Cambridge University he was a fellow and president of the Royal Society. His book *The Theory of Sound* remains a landmark text in the development of acoustics.

R W B Stephens Medal 2007

The R W B Stephens Medal was named after Dr Ray Stephens, the first President of the Institute. His main interests lay in physical acoustics but he is remembered by generations of students for his continuing work in education. The medal is awarded in alternate years for outstanding contributions to acoustics research or education.

Nominations forms are available from the Institute of Acoustics website at <http://www.ioa.org.uk/medals.asp> or by contacting Linda Canty at the IOA on telephone 01727 848195, or e-mail linda.canty@ioa.org.uk

Nominations should be marked 'confidential' and addressed to the President of the Institute of Acoustics at 77A St Peter's Street, St. Albans, Hertfordshire, AL1 3BN. The deadline for receipt of nominations is 31 January 2006.



Spring Conference 2006

Futures in Acoustics

Today's research - Tomorrow's careers

The world of acoustics is changing fast and the UK is at the centre of the European knowledge economy. The demand for people with acoustic knowledge and skills has never been greater.

To reflect this the Institute of Acoustics 2006 Spring Conference, to be held on 3 and 4 April at the University of Southampton, will focus on the twin themes of research and employment in acoustics. The conference will include:

- Sessions of technical papers in all branches of acoustics (physical, medical, environmental etc)
- Special sessions on novel and innovative applications in acoustics
- Plenary session on career opportunities featuring an Employment Forum bringing together potential employees and employers.

Students at all levels (undergraduate, MSc, PhD, IoA Diploma etc.) and young members in both full and part-time employment are particularly welcome.

More information is available on the conference web site at:

www.isvr.soton.ac.uk/fdag/ioa_spring_conference.htm

To register an interest please contact Linda Canty at linda.canty@ioa.org.uk or telephone 01727 848195.

Award Winner

Student's outstanding performance nets Institute of Acoustics' prize

Congratulations to Simon Faircloth, who is this year's winner of the Institute of Acoustics' Prize for Best Diploma student.

Dr Tony Jones, President of the Institute, presented Simon, who works for Interfloor Ltd, with his prize of £250 at the recent Autumn Conference.

The annual prize for the Best Diploma Student is designed to encourage students who have performed well in their studies for the Institute's Diploma in Acoustics and Noise Control. Simon, who studied at Salford University, was chosen from three final candidates all of whom achieved merits. He obtained the highest marks and demonstrated an excellent all-round performance, obtaining

merits in all his examination modules and his project. The modules included general principles of acoustics with specialist modules on architectural and building acoustics and noise control engineering.

Part of Simon's package of excellence was his project for the Diploma which investigated the impact sound insulation of resilient flooring material and identified the possibility of developing novel performance indicators for assessing these materials. His work has contributed to our understanding of how these materials behave, which can be an important aspect in multiple dwellings where noise from footfalls is an important issue.

On receiving his award, Simon said 'This award



was rather a pleasant surprise. Although it required a lot of hard work, the Diploma was very enjoyable and I think has been invaluable in broadening my knowledge of acoustics, especially in relation to my particular field of sound insulation design'.

Tony Jones, President of the Institute of Acoustics, added 'The standard of the 2005 Diploma students was exceptional and we congratulate Simon on his performance'.

Editor's Notes



Ian F Bennett BSc CEng MIOA.

I note from a press release on behalf of the Siemens research and development facility that football fans could soon hear what players say to each other - and the referee - on the pitch. Apparently professional football players may have to watch their language, because of the development of an innovative new microphone which pinpoints sound sources and allows them to be separated from background noises. This means that spectators will be able to hear exactly what players are saying on the pitch. At present, gun microphones are used to pick up sounds directly in their path, which means that much goes on out of the range of the microphone, and background noise from the crowd can predominate.

Since the start of this year's football season in August, the FA Disciplinary Committee has dealt with about 40 cases of alleged breaches of FA Rule E3: abusive and/or insulting words towards match officials, and this is nearly half of all the cases dealt with. If Siemens' latest innovation is introduced, the FA will be able to assess the remarks of players and issue suitable disciplinary action, saving both time and money. The technology could potentially be used to pick out bad language in a post-match sound-analysis.

Prominent players have been dismissed this year for abusive language, and the FA thinks that as they are idolised and watched by young children up and down the country they have a responsibility to set a good example. That view is shared by the referees' chief, Keith Hackett, who made it clear at the start of the season that abusive language would lead to a red card.

I can see the obvious benefits of the technology, not least because we will be able to hear what the referee is saying, too. The RFU introduced the 'ref mic' a couple of years ago, and it certainly helps the spectator understand the flow of the game. But then, international rugby referees rarely get their decisions wrong. The downside, however must be a decline in the skill of lip-reading...

I hope readers like the new-look Acoustics Bulletin, which is the result of the expert input from PointOne, our new publications contractor. On behalf of the Publications Committee I welcome them to the team.

Copy date for the March/April 2006 issue is 10 February, and offers of contributions are, as always, welcome.

Ian Bennett

Branch Report

Clive Pink MIOA. Eastern Branch Evening Meeting

On 26 October 2005, the Eastern Branch was treated to an excellent lecture on 'Underwater noise from wind farms and its potential effects on marine animals' by Dr Jeremy Nedwell.

The lecture put into perspective how striving for one environmental 'green' objective can easily unbalance another. The particular case in question was the push for renewable energy sources, which because of the inherent location problems are being encouraged offshore. This is regarded as environmentally friendly for human needs, but what of the impact on marine life? The lecture introduced an insight into the plight of marine species whose habitat is being changed due to the lack of understanding about underwater noise propagation.

The talk started by discussing the prediction and measurement of the effects of underwater noise on marine animals such as marine mammals and fish. This concept is still in its infancy and Jeremy Nedwell has developed a new scale, the dB(ht), which may be regarded as the dB(A) equivalent for underwater animals, which have greatly varying hearing ability.

The presentation illustrated how this new scale has been formulated and is now being applied to predict and measure the effects of noise on marine species. The presentation included demonstrations of underwater noise and provided examples of the impact experienced by individual species.

Some of the noise sources during windfarm construction, such as piling, may generate underwater levels as high as 250dB re 1Pa and above, and these are dramatically increasing the underwater background noise levels of the seas and oceans around the world. The consequences of these increased noise levels have already been detected by changes in the vocal ranges of whales. Yet offshore windfarms are only now beginning, and with as many as 2000 turbines proposed around the UK's coastline, noise could be a significant environmental impact if it is not attenuated at an early stage.

The members who attended this outstanding meeting were all captivated by the topic and greatly enthused by Jeremy's efforts to raise the profile of the problem.

We wish him well in his efforts to achieve mitigation measures within a number of offshore windfarm environmental impact assessments.

Branch Report

Yorks & Humberside

David Daniels of Bruel and Kjaer was elected Chairman of the IOA Yorkshire and Humberside Branch at their meeting in May 2005. This represents a resurgence of interest in the branch again, as is demonstrated by their recent meetings.

In May a meeting was held at Sulzer Pumps in Leeds. Following a Branch meeting. Guy Rickard of Bruel and Kjaer gave a talk and demonstration by on the use of sound intensity methods to measure sound power. This was followed by a tour of the Sulzer Pumps works, viewing their impressive range of pumps, used for example in oil and gas production.

The September meeting was held at Holset Engineering in Huddersfield, when the usual Branch meeting was followed by an interesting talk entitled 'Can the sound quality of a product increase sales?', presented by Dr Sophie Maluski of Hoare Lea Acoustics. This was followed by a tour of the turbocharger production facilities.

Grateful thanks are extended to our two hosts and our speakers. More meetings are planned for 2006, in order to continue the regeneration of this important regional branch.

David Daniels, who is employed by Bruel & Kjaer, can be reached on 0191 251 2287 or 07747 758747, e-mail: dave.daniels@bksv.com

Institute News

David Watts. New Regional Branch

The Institute of Acoustics is pleased to announce the formation of a new regional branch confirmed by Council on 13 October 2005.

The new Central Branch aims to provide a programme of meetings and a forum for IOA members in the Herts/Beds/Bucks and surrounding areas.

Members wishing to join should tick the box on the 2006 subscription notices. It is acceptable for members to join more than one regional branch.

For more information, contact the IOA Head Office or e-mail David Watts (Chair) Central Branch DavidWatts@AIROLtd.fsnet.co.uk

Sounding Off

Judy Edrich. A year in the life of the Publicity Manager

In the beginning...

This issue of Acoustics Bulletin marks the anniversary of my joining the Institute one year ago as the first Publicity and Information Manager, with the remit of raising the profile of the Institute. I thought therefore that this would be an opportune moment to introduce myself to those who still don't know me, and tell you a little bit about the past year's activities.

The first press release I wrote for the Institute was about my own appointment. It said in bold headlines that I would be **'Turning up the Volume'**. Nobody told me at the time that the idea was actually to reduce noise, not increase it! That said, I can confidently say that I have made a certain amount of 'noise' in terms of getting greater prominence in other organisation's publications for the Institute's news, events and services. The other thing I can say with confidence is that I know more about acoustics now than when I first joined. This is thanks in part to my having to read practically every Acoustics Bulletin ever produced, during my first week with the Institute.

IOA meetings

Attending meetings has been a great way for me to find out more about acoustics, while at the same time getting to know IOA members - and trying to encourage non-member attendees to join the Institute.

My first foray into the world of acoustics meetings was 'From DAT to Disk' in February 2005. This was probably not the best place for a complete novice to start to get an understanding of what acoustics was all about. But I duly sat in on most of the presentations and by the end of the day I was quite proud of the fact that I had understood at least something - although a blinding headache was perhaps testament to how much I had tried to understand. Since then I have attended all the conferences, starting with the Spring Conference, where I picked up a few pointers about BB93. The Autumn Conference taught me more about what noise annoys and noise mapping. And Reproduced Sound 21? Well let's just say that it was a fun conference but I'm still grappling with the concept of whether we should use A or D weighting in the design of acoustic instrumentation!



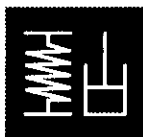
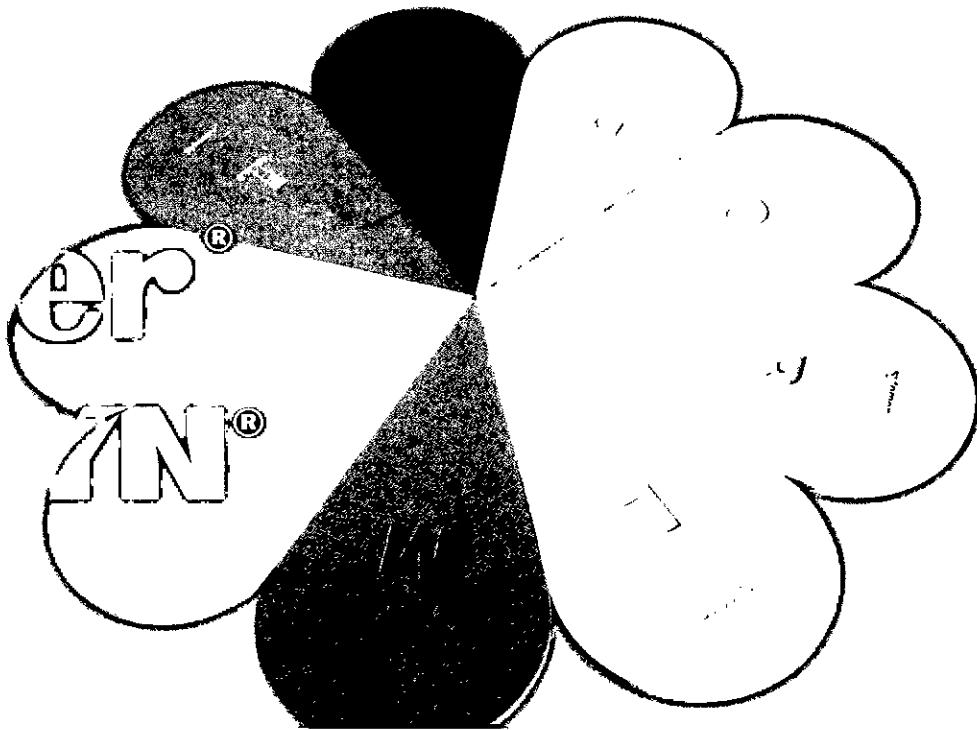
As part of European Health and Safety Week, apart from the Institute's successful meeting on Good Practice in Reducing Noise, held in Oxford, we exhibited at a local 'Stop That Noise' trade fair. Although not overwhelmed with visitors to our stand, it was more quality

Sounding Off - continued on page 11



Judy Edrich and Roy Bratby on the IOA stand at 'Stop that Noise'

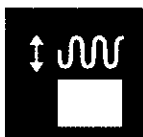
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Hilary Notley MIOA spreads the word on behalf of the Institute

Sounding Off - continued from page 9

than quantity and we did get some very important leads. My thanks go to Hilary Notley MIOA who helped out on the stand.

To help publicise Reproduced Sound 21, I descended upon the PLASA Exhibition at Earls Court in September armed with 50 RS21 promotional mugs and what seemed like thousands of bookmarks to hand out at appropriate stands. It was hard work but a number of the exhibitors did kindly agree - with the minimum of persuasion I might add - to display our mugs with the bookmarks in them. I have to say that I did see some using the mug for their coffee. However, I'm sure the message still went out, and at least the mugs didn't leak.

The Institute has co-sponsored several meetings this year and information on our activities and training courses has found its way into quite a few delegate packs. I offer my thanks to the various institutes and organisations who have distributed IOA material at their meetings.

The IOA needs you!

All the conferences and meetings I have attended have confirmed me as an acoustics convert, which is just as well as my remit is to 'spread the word'. But I do need your help, dear readers please, to do this.

Our meetings are now mentioned on the events pages of many organisations' web sites. We are getting good attendances at meetings

and we have also been successful in getting articles published in various magazines. We are now being regularly approached by magazines requesting articles for example on subjects such as sound insulation, wind farm noise or the new Control of Noise at Work Regulations. I am indebted to several members who, even with deadlines looming, have been willing to write something on behalf of the IOA, or even just mentioning the IOA. I know that I am relying on the goodwill of busy people and I need to build up a database of other 'willing victims'.

I would be very grateful, therefore, if you could let me know if you would be willing to help with articles and if so, what your specialist area is. Or, perhaps you would be willing to speak to the media or give a talk to a school, college or university? Either way, please do send me an e-mail at judy.edrich@ioa.org.uk to let me know if you can help at all. I promise I will keep my requests to a minimum!

Please also let me know if you see mention of the IOA in any journal or on any website. And don't forget, any publicity suggestions or ideas for articles or press releases are always welcome.

On another note, if you are going to a non-Institute conference where you think you could distribute IOA material, can you let me know and I will send you some information? It all helps.

The Institute's web site

The Institute's web site has come a long way

since its facelift - and I hope you have all had a look recently! The web site is regularly updated with news items and press releases so, if you have not managed to do so lately, please do have a look. Also, please let me know if you have something you think would be of interest to other members or whether you have had any good publicity - a TV interview that I can tell people to watch, a radio broadcast, anything - so that I can publicise it on the website. We are continuing to look at ways of improving the site so please visit it regularly and let us know of any thoughts you may have on how to improve it.

The future

The New Year promises to be exciting for the Institute. I believe there are still many unexplored areas where I can publicise our activities. We will soon be sending out a Membership Survey in an attempt to understand your needs, and make sure that we are providing the type and quality of service expected by our members. We would appreciate it if you could take moment to complete the survey, not least because it took ages to prepare it!

We would very much like to encourage more young people into the profession and, in collaboration with other institutions and organisations we will be working on that - and much more. But for now, all that remains is for me to wish you a very successful 2006, and I hope to hear from you soon.

Feedback To The Future

Bob Walker FIOA. Reproduced Sound 21 Conference

The 2005 Reproduced Sound Conference was held once again at the Oxford Hotel, Wolvercote on 4 and 5 November 2005. As usual, the venue facilities fitted the conference requirements well, with a comfortable lecture room and a spacious coffee/exhibition room adjoining in the hotel's self-contained conference suite. There were many opportunities for delegates to meet and talk, both in the main rooms and in the lobby.

This was the twenty-first conference in the Reproduced Sound series and the occasion was marked by the inclusion by a number of speakers of historical and retrospective comments. Nevertheless, the conference continued with its main focus on current developments in electroacoustics, room acoustics and intelligibility. In addition to two memorial lectures, 22 papers were presented in eight technical sessions by nationally and internationally regarded authors.

The conference was well attended, with 88 registered delegates. The Electroacoustics Group was pleased with the response to the programme and is planning the 22nd in the series, to be held in November 2006 at a venue yet to be decided.

The conference was opened by the chairman, Mark Bailey, who formally welcomed delegates. The first presentation of the morning was the 2005 Peter Barnett Memorial Lecture by Dr Per V Br  l. The Institute President, Tony Jones, introduced the award with a brief res  m   of Peter Barnett's work and his many contributions to the Institute's activities over a long period of time. He remarked particularly on Peter's educational activities and encouragement of young people. The Memorial Lecture was followed immediately by the first day's technical sessions, which continued with the usual breaks for coffee, lunch and tea, until the final paper at 5:10pm.

The Electroacoustics Group AGM was held immediately after the last technical session of the day.

The AGM was followed by a sherry reception, sponsored by Ken Dibble Acoustics, to celebrate Ken's 60th birthday that day. Ken is a stalwart of the RS conferences, having attended every one of them, and he has provided the conference sound reproduction facilities every year. The reception was followed by dinner.

To mark the occasion a special event was organised for the remainder of the evening. The plan was for delegates to provide older equipment for exhibition. John Watkinson agreed to provide an 'Antiques Road Show' style presentation, in which he made comments on some of the exhibits. In the event, the occasion went very well indeed. A large number of older items had been provided, many by the PA Museum in Norwich. John picked out examples, beginning with the oldest non-electronic equipment, including a completely mechanical chart recorder for recording vibration waveforms, and an original 1921 phonograph in excellent condition. Another very early artefact was an original Rice-Kellogg 'Celestion' cane-and-tissue-paper loudspeaker. With each exhibit, he gave a personal view and fitted it into the history of sound recording and reproduction. The range of exhibits was remarkably extensive and included tape recorders of the kind that appear to be bolted down, blast-proof loudspeakers from the RAF, and elderly B&K measuring instruments. There were amplifiers of different vintages, many of which would be regarded as lethal today with their exposed high voltages and sharp corners. Several compression drivers, including one from the early 1920s, were on show, together with some complete horns and a number of microphones. John's presentation was interspersed with live songs from Lisa Marshall, using his own design of high quality music loudspeakers as the PA speakers. A very enjoyable and informative evening was had by the large number of delegates who stayed until the 11:30pm finish.

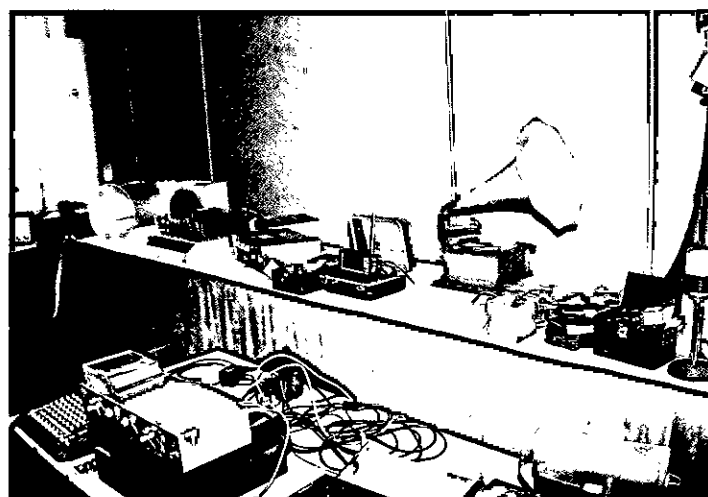
The second day of the conference started with the technical sessions at



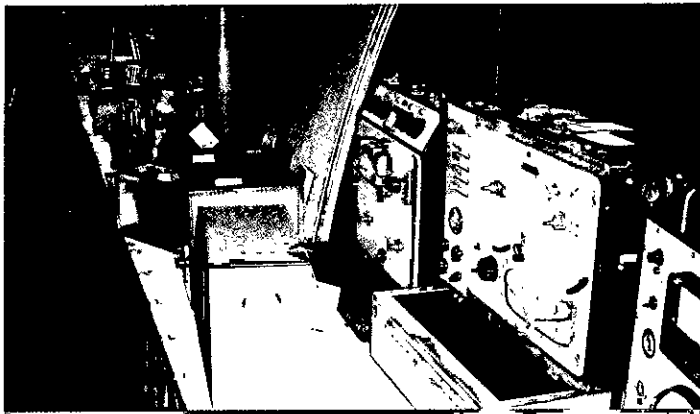
L to R: Judy Edrich, Roy Bratby, Tony Jones



Dr Per V Br  l receives his Peter Barnett Memorial Award



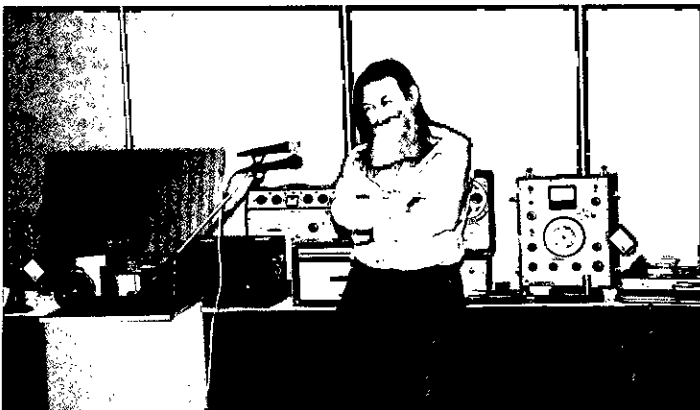
Acoustics antiques road show exhibits



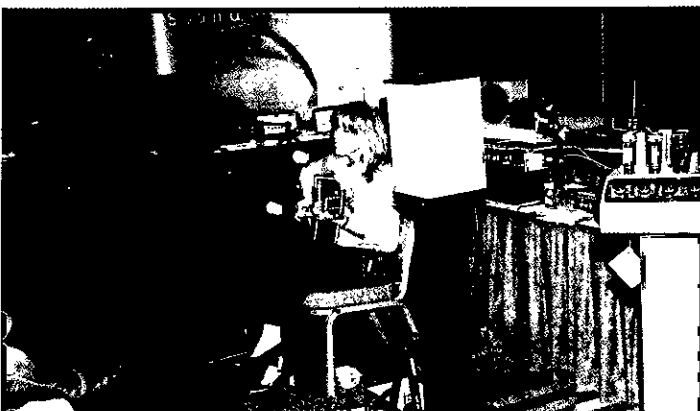
Acoustics antiques road show exhibits



Ken Dibble receiving his card and gift on the occasion of his 60th birthday



John Watkinson entertaining the delegates



Professional musician reinforced by John Watkinson's latest precision loudspeakers

9:00am. They continued until the last technical paper of the conference at 4:30pm. That was followed by the 2004 Peter Barnett Memorial Lecture by Prof James Angus. His title was 'Spherical chickens and sound reinforcement: how Fourier rules the roost' (reported separately).

A Sherry Reception was held immediately after the last session of the day, and the formal Conference Dinner followed the reception. After dinner, the Institute President, Tony Jones made a brief speech, remarking on the continuing success of the Reproduced Sound format and thanking the committee for their organisation. In a responding speech Mark Bailey thanked the rest of the committee and the hotel staff.

The Dinner was followed by another special event, in the form of a Quiz Night entitled 'Audio Obscura'. It was presented by Peter Mapp, who had designed the questions, and Mark Bailey. The questions were mainly related to audio and acoustics and were not intended to be the 'normal trivia type', but rather aimed to expand and stretch the mind. They certainly did that - even the winners only scored about half of the available points. Although most of the questions were technical, there were general knowledge aspects to many of them so that the non-acoustician members of the audience could take part. The final scoring scheme was strict, with only small margins of error allowed to gain part marks and no margin at all for full marks. The winners received a half case of 'bubbly', which they then generously shared out amongst all of the tables. During the quiz, there was an interlude in which the audience was treated to a version of the famous 'Four Candles' sketch performed by Mark Bailey and Paul Malpas, with Paul looking most convincing in his workman's costume, although Mark had some trouble keeping a straight face. At the end of the quiz the audience was treated to a recitation of the '2D Bees' by James Angus, with the aid of some helium from one of his famous balloons.

Overall, the organisation of the conference went well, with some sort of activity taking place all of the time. The delegates certainly appeared to have had an enjoyable and worthwhile conference, with many already looking forward to the 2006 conference.

Technical sessions

Measurement

The first Technical session was chaired by Peter Mapp. The opening presentation was the Peter Barnett Memorial Lecture by **Per V Bruel** (Bruel Acoustics, Denmark). The subject was 'From sound level meters to RaSTI - the development of the first sound level meter and the frequency- and time-weighting'.

Simon Khan (Capita Symonds) then presented his talk on test signals for the assessment of annoyance from amplified music. In his brief historical introduction, he described how sound engineers in broadcasting and telecommunications used to be concerned exclusively with reference levels, alignment signals and dynamic range. With usable dynamic ranges of only 35-40 dB, great care had to be taken to make sure the signal neither overloaded nor disappeared into the noise. With improvements in technology in the 1970's the situation improved, but care still had to be taken with gain distribution, especially in theatres, which were generally more critical than broadcasting or recording.

Test signals used for quality assessment or alignment have included swept sine waves and pink noise. Measurement systems such as MLSSA or TDF can obtain large amounts of technical data but are of little use for quality assessments. Eventually, people use their favourite musical excerpts. However, they usually end up listening to the music and not to the system being set up. Commercial recordings are designed to sound good on a wide range of systems, just the opposite of an analytical signal.

Simple recordings are more useful for test purposes than over-produced tracks. For assessment of PA systems speech is best. A re-recorded version of the well-known BBC test track 'Journey to Yorkshire' has been produced, together with a recording of a mock 'Weather forecast' with a small amount of compression.

Overall, different signals are useful for different tasks. However, none of those described so far were of any use for setting levels and assessing

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Feedback to the future - continued from page 13

likely disturbance for a pop concert. A-weighting is of little use for the low frequency content that is most likely to be annoying. Pink noise had been tried but it had insufficient low frequency content. A test signal with specially-shaped spectral content had been developed, with an element of 'beat' included to make it recognisable amongst the background noise at a distance.

Psychoacoustics

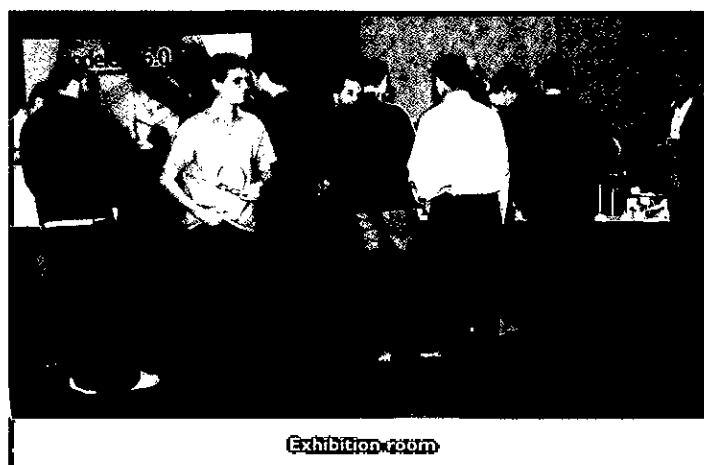
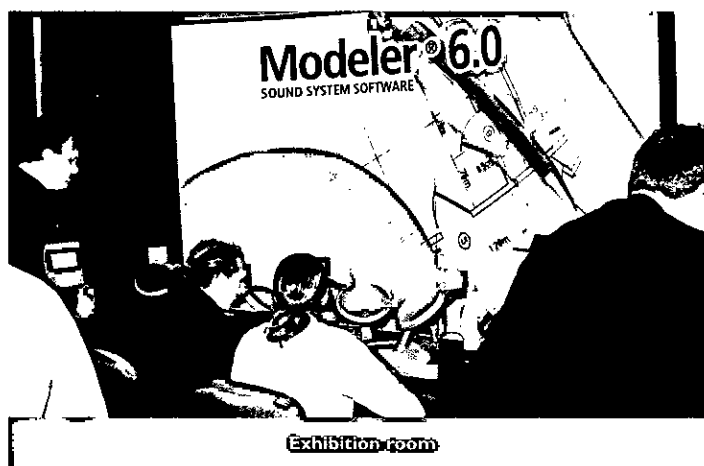
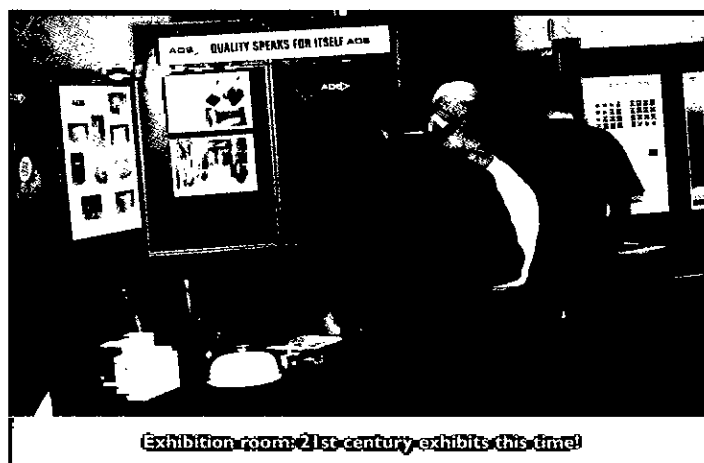
The session on Psychoacoustics was chaired by Robin Cross. The first presentation of the session was on multichannel audio in cars. The paper had been prepared by Tim Nind (Harmon Becker Automotive Systems) who could not be present. It was presented by **Danny Burns**, who began with a brief history of multichannel sound. The room response could be split into three parts: the direct sound, the early reflections and the reverberation. The Lexicon 'Logic 7' system gives every listener a 'good' experience. From a two-channel input, the system identifies the loudest sound vector and steers the sound output to the appropriate output channel via the output matrix. With multichannel inputs, more data is available for the system to reproduce more of the desired sound stage.

Cars are very different listening environments to rooms. The listeners are always off-centre and the passenger compartment is divided into two by the front seats. The main loudspeakers in vehicles are usually positioned in the doors, with an additional loudspeaker in the front dashboard and surround speakers in the rear parcel shelf. Rear seat passengers have difficulties if the front sound stage is presented from the front loudspeakers. It is also made more difficult because of the lack of consistency in the way channels are used in recordings. In the new system, a seven-channel matrix provides the outputs for the main loudspeakers. Contributions from the front sound stage are added to the rear seat loudspeakers to create a distinct and separate sound stage for the rear seat passengers.

The second speaker, **Mike Hollier** (Psytechnics) presented a new generation of perceptually based speech quality measurements. Conventional measurement methods fail to identify subjective quality, especially for the sorts of distortions introduced by modern transmission systems. With such systems, there are problems even identifying exactly what is meant by 'quality' in the presence of latency and packet loss. The final arbiter is a subjective assessment, using Mean Opinion Scores but until now these have not correlated well with objective measures.

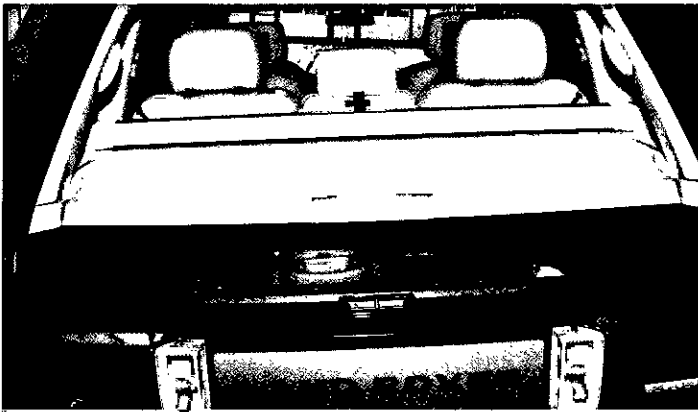
Two basic methods have been used for objective quality measurement. The first, called 'active' or 'intrusive', uses test signals and direct comparison between input and output to quantify the distortion products. That cannot be used on working circuits because it occupies the channel, but it is the most widely used and validated technology. It is implemented in ITU-T PESQ standard (P.862). The second method, passive, uses the existing signals. It has two options, either to monitor the transmission circuit performance parameters or to decode and monitor the actual speech signal. For the first, the circuit parameters are used with a model of the final output device to predict the likely quality. That does require knowledge of the final device and for its behaviour to be quantified in advance. For the second method, the key to the prediction method was to recognise that the source was a human voice. Models of vocal tract behaviour could then be used to identify the likely differences between the 'intended' and eventual speech quality and thus derive a performance indicator. That is now embodied in ITU-T P.563.

The third speaker in the session, **Tim Jackson** (Manchester Metropolitan University), presented a talk on perceptually masked audio sub-channels and applications. The concept was similar to watermarking, which is always a trade off between perceptibility, robustness/security and data rate. Most work on watermarking is aimed at low data rates and secure transmission of hidden data. The intention with this work was to provide a rather less reliable but much higher data rate hidden signal that could be used to embed one audio signal within another. The basis of the method was to identify frequency components that were below the perceptibility threshold, in a similar way to audio compression systems, and to replace them with data from another audio signal.

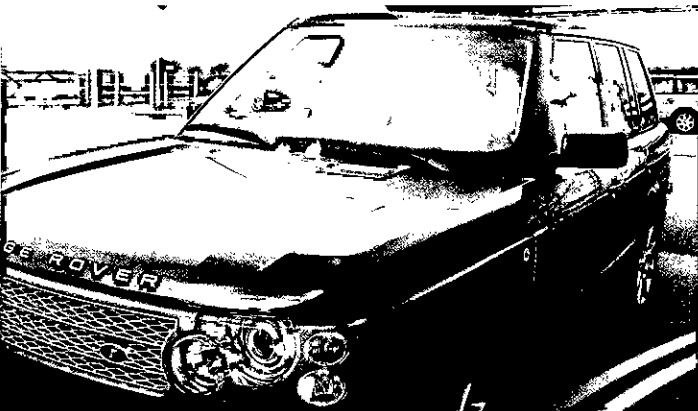




Mark Bailey showing off his new digital camera



Rear view of Range Rover equipped with Harman Becker high resolution multi-channel audio and video, now fitted as standard to this flagship model



External view of Range Rover



Rob Harris gives his historical review of the role of consultants in audio system installation

In experimental tests, the results showed that listeners could not detect the difference between the original signal and one with hidden data carrying a telephone quality channel.

Room acoustics

The session on room acoustics was chaired by Bob Walker. The first presentation of the session was by **Keith Holland** (ISVR) on excess phase effects and modulation transfer function degradation in relation to loudspeakers and rooms intended for the quality control monitoring of music. Previous papers had discussed the effects of loudspeaker alignment and resonances on the accuracy of reproduction of low frequency audio signals. A system of modulation transfer function (MTF) measurement had been developed which incorporated both the time and frequency domain information into a single measure of response accuracy. The presentation extended the previous work into the listening room and assessed the loss which might be incurred as the sound travelled across rooms with different modal characteristics. Comparative measurements of low-frequency modulation transfer function had been made in a high quality and a low quality room, with high quality and domestic quality loudspeakers. Results were presented for 1 m and 4 m distances from the loudspeaker. The results showed that the MTFs were more uniform for better rooms and better loudspeakers and were maintained at 4 m distance. For lower quality rooms or loudspeakers, the MTFs were less uniform and became worse at 4 m distance. Room equalisation could reduce the response losses at closer distances but gave little or no improvement at further distances.

The second paper of the session was presented by **Bruno Fazenda** (University of Glamorgan) on the time domain performance of standard listening rooms, the assessment of current rooms and recommendations for achieving improved compatibility. Since the mid-1970s, many efforts have been made to define recommended standards for listening rooms and control rooms for the broadcast industry, for example by the EBU and the IEC. However, it has also been recognised that many of these rooms can sound very different, despite meeting the specifications.

One of the significant problem areas is the low-frequency responses, usually dominated by room modes. Idealised 3D plots of the responses for bandwidths of $2.5/f$ and $5/f$ were shown and compared with the EBU limits for low-frequency reverberation time. It was shown that the reverberation decay was longer than the idealised loudspeaker response decay and that the performance of such loudspeakers could not be evaluated in such rooms. Some work on the perception of room modes was described, confirming the detection threshold of 'Q=15'. It was suggested that the EBU/IEC Recommendations should be reconsidered, especially for the low-frequency response times.

The final paper of the session was presented by **Andrew Goldberg** (Genelec Oy) on a listening test system for measuring the threshold of audibility of temporal decays. The paper described a method for measuring the audibility threshold for the decay time of low frequency resonances. The system used a synthesised low-frequency resonance and both artificial and natural test signals. The psychometric factors included the programme material, the replay level and the resonance centre frequency. The method employed the Parameter Estimation by Sequential Testing (PEST) technique and was carried out using calibrated headphones to remove the effects of the listening environment. The method used the simple binary forced choice of whether any difference could be heard with the addition of the artificial resonance.

A trial listening test showed that the system gave reasonable results but the temporal resonance modelling filter required some adjustment to remove audible non-modal cues. Transducer limitations affected the test at low frequencies and high replay levels. The factors that needed refinement for a future large-scale listening test were identified. Early indications were that temporal decay thresholds increased with lower frequency, shorter decay and increased sound level.

Loudspeakers I

The first session on loudspeakers was chaired by Sam Wise. The first presentation of the session was by **Paul Darlington** (Apple Dynamics Ltd) on two port models of the loudspeaker. Such models provide

continued on page 16

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Feedback to the future - continued from page 15

compact descriptors of linear systems and are widely used in electrical network analysis. They are also amenable to modelling transducer systems, such as loudspeakers, where they afford some practical advantages. The purpose of the paper was to demonstrate the relationship between the two port model and the more familiar 'analogous circuit' model of the low frequency behaviour of a direct radiating electrodynamic loudspeaker. After a brief review of the two port model of a loudspeaker, a general method was presented for the derivation of Thévenin and Norton equivalents of 'transmission' two ports, in four easy steps. The resulting Thévenin equivalent was shown to be identically the standard low frequency analogous circuit of a loudspeaker. Demonstrating this identity is useful as it allows two port parameters of the loudspeaker to be used in the many system design methods that were developed in the context of the electrical equivalent circuit. Additionally, the identity suggested a new method for deriving the analogous circuit, which avoided the 'twists and turns' of traditional derivations and so might be of considerable educational value.

The second paper of the session was by Guido Noselli, who could not be present. The paper was presented by **Steve Smith** (Outline UK) on reflective wave guides for the reproduction of high frequencies. The paper began with a brief description of the established technology of folded horn loudspeakers and then went on to describe the main aspects of a new approach, using 'reflective wave guides'. Using curved reflecting surfaces with a conventional horn loudspeaker source allowed the radiation angle and the location of the virtual source to be manipulated to give the required radiation pattern. It described a specific application of a prototype device for which a combination of the principles of acoustic diffraction and absorption was applied, in addition to the reflection principle.

A second device was described as being particularly suited for use in modern vertical line arrays. Both devices are currently being used in high performance professional loudspeaker enclosures. Traditionally, clusters





Helen Goddard, AMS Acoustics, chairs the Intelligibility session



Peter Mapp delivers his usual supercharged talk, this time on 21 years of Reproduced Sound and Beyond



James Angus gives the Peter Barnett Memorial Lecture 2004, together with the usual outrageous illustrations



James Angus demonstrates a square embouchure

of constant directivity horns have been used but they give rise to interference problems, low sound levels and gaps in the coverage. They are also large and heavy. Controlled coverage using these reflection principles allows the radiation pattern to be adjusted to better fit the requirements.

The final paper of the first loudspeaker session was an invited paper by **Bruce Howze**, (Community Light & Sound, Inc.) on cone drivers, some recent work on cones, suspensions and cooling. Loudspeakers generate a considerable amount of heat when operated at high power levels. Cooling will increase its performance and power capacity, and probably also its useful life. The heating is also responsible for a reduction in efficiency at high power levels. Three methods for loudspeaker cooling were presented. The first was the use of an airflow director to constrain the natural airflow caused by the motion of the cone close to the surface of the voice coil. An example provided a 6°F reduction in voice coil temperature. The second method used in addition a small fan cooling the magnet structure. That provided a total of 40°F reduction. The third method used forced ventilation of the voice coil and magnet. That provided a 70°F reduction and showed that the temperature had stabilised after 30 minutes, unlike the previous two cases where the temperature was still rising after more than two hours.

The paper then showed how the cone and suspensions of a loudspeaker have a significant effect on both acoustical and mechanical performance. Experiments with carbon fibre reinforcement had demonstrated that the strength and stiffness could be improved with relatively small additions of carbon fibre rings. That led to a reduction in high frequency resonances and the potential for improvements in the strength, especially where the surround joins the cone, which is where many loudspeakers fail when subjected to severe overloading.

Loudspeakers 2

The second day of the conference began promptly at 9am with the second session on loudspeakers, chaired by Julian Wright. The first paper was by **Evert Start** (Duran Audio) on the optimisation of DDS-controlled loudspeaker arrays using a hybrid PSM-BEM model. Using Duran Audio's Digital Directivity Synthesis (DDS) technology, any desired 3D array response can be synthesised. In order to calculate the 3D pressure response of a DDS-driven array a simple Point Source Model (PSM) is used. Each loudspeaker in the array is modelled as a directional point source, positioned in free space. It assumes that the sound field of a loudspeaker is unaffected by the presence of the other cabinets in the array and identical loudspeakers in the array can be modelled with the same free field directivity function. Moreover, measurements on a relatively small loudspeaker cabinet can be done in an anechoic room.

The free field assumption yields accurate results for higher frequencies but, for lower frequencies, deviations between the predicted and measured array response may occur because of the presence of the other loudspeaker cabinets. Although these deviations are usually small, they can become more problematic for an accurate simulation of LF cardioid arrays. To improve the PSM, the spectral and directional characteristics of each loudspeaker at its actual position in the array should be known. However, due to the large array dimensions and unlimited number of variations in array set-up, anechoic far field measurements of each loudspeaker at any position in array are practically impossible.

Using the acoustic Boundary Element Method (BEM), it is possible to accurately model diffraction and coupling effects for low and mid frequencies. Unfortunately, direct implementation of the BEM into the DDS algorithm would lead to dramatically increased computation times. Therefore, a computationally efficient, hybrid PSM-BEM approach is being developed in which the BEM modelling is done off-line and the results imported into the PSM model. The results showed comparisons between some calculated and measured responses for arrays of cabinets.

The second paper of the session was by **Lamos Ferekidis** (R&D Team) on the benefits of using directional low-frequency loudspeakers in rooms and especially using multiple low frequency cardioids in small rooms. Changing the orientation of the source can control the coupling

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Feedback to the future - continued from page 17

of a directional source to a particular room mode. The benefits of cardioid subwoofer arrays were explained. Beside the ability to control specific room modes, the decay times of fundamental modes could be reduced. The level variations measured across the listening area were also reduced. It was also shown how the decorrelation of the individual subwoofer signals could affect the perceived sound quality and spaciousness. Recommendations were given how a proper choice of the LFE-crossover frequency can be used to extend the perceived spaciousness. The use of mono or stereo bass was also discussed. It was suggested that mono was best in smaller rooms and stereo only worked in larger rooms. Two cardioids either side of the listener at right angles gave a reasonably even low frequency response over a wide listening area.

The final paper in the loudspeaker sessions was presented by **Graham Bank** (Deben Acoustics) on the Balanced Modal Radiator (BMR). Most loudspeaker designers start by considering the loudspeaker as approximating to a 'perfect point source', and then accepting the limitations of such an approximation for practical devices. Analysis shows that there is an alternative prototype for a device that behaves like a perfect point source, but it does not indicate an obvious embodiment. Based on that prototype, a practical flat diaphragm loudspeaker had been developed that had a substantially flat on-axis frequency response and an extended, smooth acoustic power response.

For a modal object, the complete response may be considered as a sum of partial responses, each of which is related to an individual mode of that object. The on-axis pressure of any flat object is a sum of the 'piston' response and the modal contributions. For the case of a free disc, the mean volume velocity of the non-piston modes is zero, so that they will not contribute to the on-axis response. By applying an 'ideal force' to that disc, it can be turned into an 'ideal loudspeaker', with a flat on-axis response and an extended, smooth acoustic power response.

In practice, the force delivered always has mass associated with it. That mass at the drive point unbalances the mode shapes and perturbs both the pressure and power responses. By adding additional masses at prescribed positions, it is possible to recreate the mode shapes of the free disc and thereby restore the original response. A Finite Element Analysis model was used to determine the basic performance characteristics in both the mechanical and acoustical domains. Results from the analysis were compared to measurements from a test loudspeaker. At the end of the talk, a demonstration of a Balanced Mode Loudspeaker was given. Many of the delegates present were greatly impressed by the performance of the prototype loudspeakers, achieved without the need for high-damping material.

Amplifying, Enhancing and Achieving

The second session of the day was Amplifying, Enhancing and Achieving and was chaired by Mark Bailey. The first paper, by **Jim Stembel** (Crown International), was on Class A to class I, 50 years of the power amplifier. Amplifier technology has changed much over the last 50 years, from valve designs and single transistors, multiple transistor designs to FETs, a variety of amplifier classifications and new digital designs. Amplifier technology is driven by many factors, including customer expectations and competition. The paper presented some of the history, with a specific view to the future and the latest design challenges of higher powered digital amplification and lightweight power supplies. The topology of the latest balanced current amplifier was described, together with its advantages of low quiescent current, lower clock rate for the same ripple and the cancellation of all switching frequency odd harmonics.

The second paper in the session was given by **Rob Harris** (Arup Acoustics) on the consultant's role in audio system installation - the last 25 years. The specification and procurement of audio systems did not always involve the services of acoustic consultants. However, when clients begin to recognise the need for audio and don't understand the technology, many turn to consultants to help them decide how to spend their money. The need for audio might be driven by safety requirements,



On the occasion of Ken's birthday...



ICA President, Tony Jones, introduces the after-dinner presentations



Dr Per V. Brüel receives his Peter Barnett Memorial Award



Bronwyn Bird receives her Award for Promoting Acoustics to the Public

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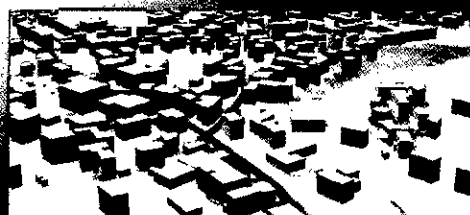
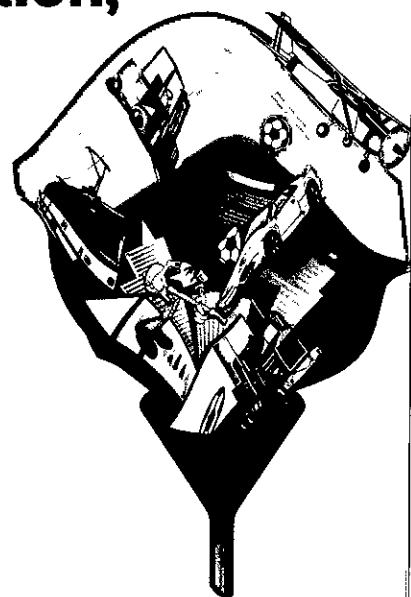
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Feedback to the future - continued from page 21

Peter Barnett Memorial Lecture 2004

Prof James Angus (University of Salford): *Spherical chickens and sound reinforcement – how Fourier rules the roost*

James took as his formal subject a comment by Peter Barnett, who was always simplifying problems down to the bare essentials in order to illustrate a particular point. In one of his lectures on sound reinforcement he had said, 'Assume that we have a loudspeaker that has a trapezoidal coverage area, and so perfectly covers the room'. The lecture examined the possibility of creating such a mythical loudspeaker. In particular, it examined the power of Joseph Fourier's theorem to help envisage and create such a beast.

In his usual inimitable style, James treated the audience to a brief biography of Fourier. He described how that revolutionary and important theory had been rejected by his peers, at least until Fourier had reached a position in scientific society where he could directly influence its publication.

James then introduced the application of the Fourier transform to acoustics, taking as an example the derivation of the far-field response for a line array of sources. Using a selection of props, mostly of the inflatable kind, he illustrated the results of applying the theory to a range of modern acoustic problems. Inflated rubber gloves and balloons of various shapes showed graphically the general shapes of the results and how responses narrowed with increasing acoustic aperture. Using a large bottle of gin and a (not very) small glass, he also managed to contrive a demonstration of how objects large in one domain become small in the other, at the same time as mixing and drinking a gin and tonic. To introduce the topic of PA, James briefly demonstrated a novel system, utilising the very latest technologies of string and tin cans to address the audience, though it has to be said that its coverage and frequency response would need additional development work. For his



Mark Bailey and Peter Malpas running the Anniversary Quiz

underlying theme James showed that the required trapezoidal radiation pattern was not achievable within real-world constraints.

The talk was very well received by the capacity audience, who by the end had been treated to an entertaining and amusing talk on a serious and important technical subject.

Peter Barnett Memorial Lecture 2005

Dr Per V Brüel: *From sound level meters to RaSTI – the development of the first sound level meter and the frequency-and time-weighting*

Dr Brüel began with the early history of early wireless developments and acoustics in Germany and Denmark and how the focus of sound

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level measurement moved to the USA in the 1920's, with many systems being designed and marketed there. Without formal standards, there was much variation in specifications. Then, the formative work by General Radio in the late 1920's quickly led to ASA standards, which in turn led to the world standards that are still essentially in use today. The story behind the origin of the 'acoustic inch', and why a one-inch microphone is today still less than an inch in diameter, were described, to the amusement of the audience.

Dr Brüel then spoke about the work done in America, at Bell Laboratories, and in Europe on the measurement of the hearing sensitivity curves and the development of the A-, B- and C-weighting curves. He also spoke of the sometimes large errors caused by the differences between the standard curves and the actual hearing sensitivity that have plagued measurements ever since. He described the work of Zwicker in the development of better approximations and the D-weighting curve. He made a few wry comments on the special problems encountered when jet aircraft were introduced and the method used today for measuring aircraft noise - one weighting curve for small aircraft and a different one for larger ones.

Dr Brüel then went on to talk about time weighting. He said that the 125ms 'fast' time constant was actually the mechanical response time of the first Weston meter, the fastest that could be achieved at the time. In later work in ISO on faster time constants for impulse noise, the 35ms standard arose as the only point of compromise between some people wanting 15ms and others wanting 150ms. He told the audience that there was no other scientific basis for the value finally chosen.

Dr Brüel then described the first constant percentage bandwidth analyser in the world, developed by himself in 1938, and using no inductors, which he implied were difficult and unsatisfactory components, especially for portable equipment. He then went on to talk about hearing damage and said that the important factor was the total sound energy. With impulsive noise, that could be higher than a normal sound level meter would indicate, introducing the need for fast attack times. The use of A-weighting was almost universal and usually wrong. He described his recent experiments on the duration of metal-to-metal impacts and showed that the harder the impact the shorter the noise impulse.

He finished his talk by describing briefly the current development of a new hearing risk analyser. That was based on a human torso model because directionality was an important effect for the high frequencies impulses responsible for hearing loss. Overall, Dr Brüel had presented an informative and often very amusing history of his involvement in many aspects of acoustic measurement.

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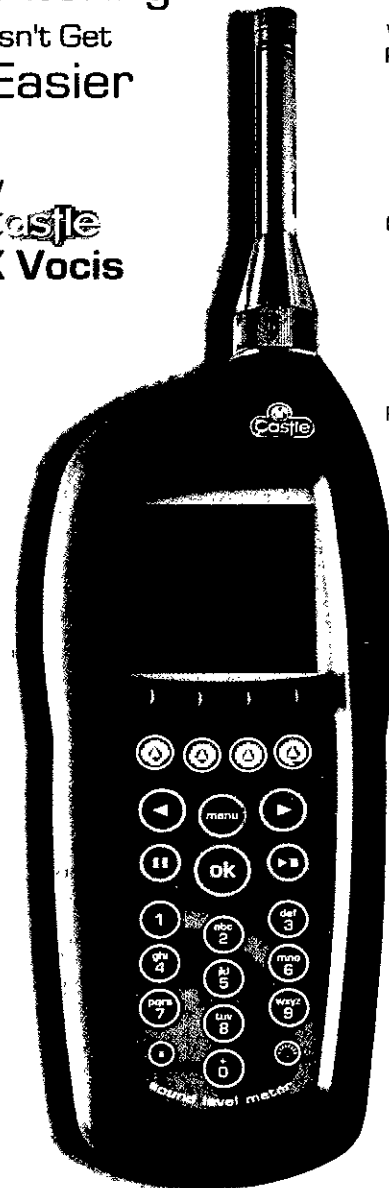
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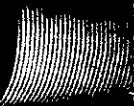


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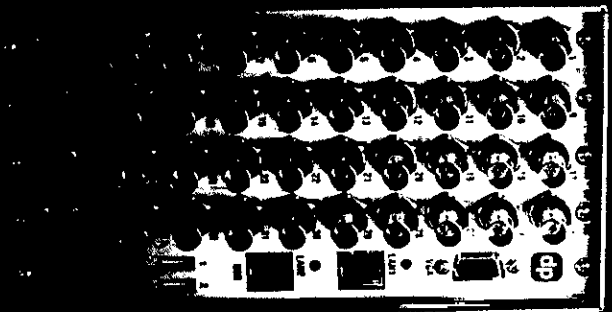
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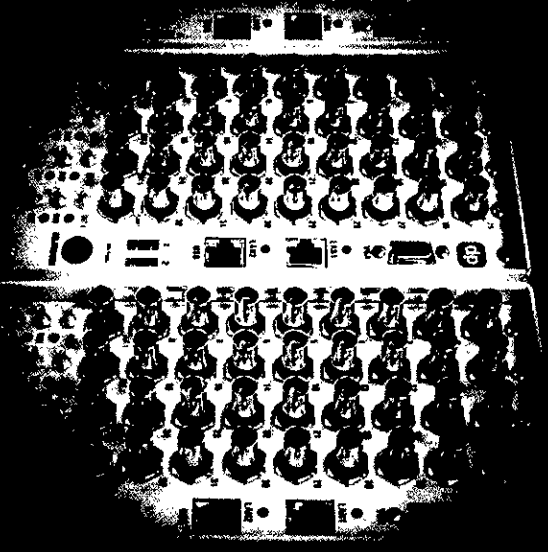
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Towards Virtual Sound For Aircraft Simulation

Patrick Chevret, R Maier, JM Nogues, J Perisse & C Thirard.

Introduction

Within the European funded project SEFA (Sound Engineering For Aircraft) a method generating a synthesis sound targeting the noise signature of a flying aircraft was created. The purpose of this article is to describe this method and to demonstrate its quality level through a sound demonstration on a test-aircraft.

First the noise sources as the different physical effects composing an aircraft noise signature are enlisted. Then, the methods used to synthesise these components and these effects are detailed. What brings each of these steps to approach the global noise signature of the test-aircraft is illustrated thanks to a 'progressive' sound demonstration. To establish the quality of the method, the synthesis sound is finally compared with a real noise measurement of the test aircraft.

Method for the noise synthesis of engine sources

General procedure for aircraft noise simulation

Engine noise is composed of several distinct types of sources. Each source has its own frequency spectrum and directivity, which depend on the engine speed.

Based on the spectrum for each noise component, a common source classification can be established:

1. Harmonic noise including the *fan noise*, the *compressor noise*, the *turbine noise*,
2. Broad band noise, corresponding to the background spectrum of contributions from jet and combustion noise.

The method for the noise synthesis is directly linked to the class to which the source to be synthesised belongs. The harmonic and broad band sources are treated independently in a different way (described below), the synthesis depending on flight parameters such as engine speed and directivity. The sources are then summed and used as inputs to the time-varying propagation filters.

It should be noted that aerodynamic noise of the aircraft is not considered in this article, but if it were, the approach would be similar to the broad band synthesis.

Synthesis of harmonic noise

The method for tonal components synthesis (including harmonic noise) consists in calculating at each time the sound pressure $P(t)$ from the amplitude and the phase (if provided) of each harmonic - for a given engine speed - which make up the harmonic

noise spectrum. The expression for the computation of acoustic sound pressure by summation of all harmonics contribution is:

$$P(t) = \operatorname{Re} \left\{ \sum_{n=1}^N [a_n(t) \exp(jn\alpha(t))] \right\} \quad (1)$$

where a_n are the complex amplitudes of harmonic n and $\alpha(t)$ is the instantaneous engine shaft angle which is expressed in stationary condition as $\alpha(t) = \Omega \times t$, where Ω is the engine speed.

The amplitude and phase information may come from measurements at static conditions or computations from numerical models. Then, when changing the engine speed for instance, harmonic values are interpolated in the Nyquist plane.

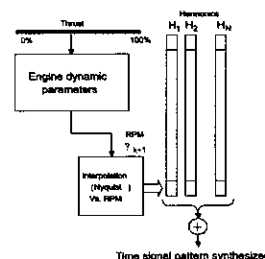


Figure 1: General layout of harmonic noise synthesis.

For non-stationary condition the computation of the shaft angle at each instant t_k (where $t_k = k \times \Delta t$) is performed by a time dependent numerical integration of the engine speed:

$$\alpha(t_k) = \left(\frac{1}{2} \Omega_0 + \sum_{i=1}^{k-1} \Omega_i + \frac{1}{2} \Omega_k \right) \times \Delta t \quad (2)$$

where Ω_i is the engine speed at instant t_i (computed by interpolation from the time history of the engine speed).

Synthesis of a broadband noise

The principle for the broad-band noise synthesis is the time convolution of the impulse response calculated from the noise power spectral density (expressed either as a narrow band or a third octave band spectrum) with a white noise of zero average and 1 variance²:

$$P_{BB}(t) = \text{FIR}_{BB}(t) \otimes S_{WN}(t) \quad (3)$$

FIR_{BB} is the finite impulse response of the broadband noise and S_{WN} is a white noise signal.

The variation of the broad-band noise versus the engine speed is performed by a linear interpolation between two spectra of known noises (according to engine speed) or, if

existing, by interpolation according to simple physical law.

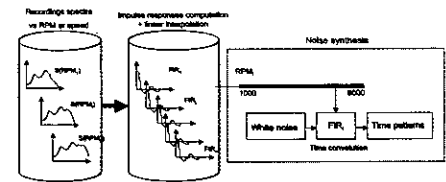


Figure 2: General layout of broad-band noise synthesis

Validation in static test bench conditions

In this section, we apply the synthesis method presented above from measurement made on real engine at static bench conditions. First, the sound pressure field (in the form of a temporal signal) is measured at different angles around the engine (at a fixed engine speed). Typically, a 10° sampling is performed. Then, from the computed spectra at each angle, the harmonic energy and background noise are extracted.

The synthesis finally consists in applying, first the method presented in section 2.2 for harmonic components and then, the one presented in section 2.3 for background noise. A listening comparison between the measured signal and the synthesized one shows the relevance of the approach at all the angles. Moreover, from this static data some simulations can be performed. For example, a person walking around the engine and the perception of sound all along the path is simulated. The obtained sounds are judged as very realistic.

At this stage, the synthesis was applied only for an engine lying on the ground. The challenge is to extrapolate from this ground data to in flight signals, including a simulated flight path and propagation transfer function. This is the aim of next section.

In-flight noise synthesis including modelling of propagation effects

For the conversion of static noise data into flight a couple of effects have to be considered. For aircraft noise prediction all these effects are considered usually in the frequency domain by applying deltas in 1/3rd octave band data. An overview of the effects relevant for aircraft noise prediction are visualised in figure 3.

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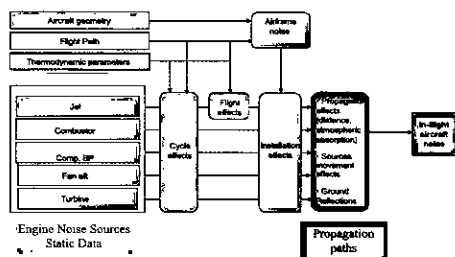


Figure 3: Typical aircraft noise prediction scheme

In a first step flight effects have to be taken into account, i.e. mainly impacts on the source itself due to :

- thermodynamic effects on noise sources (atmospheric conditions, altitude)
- cycle effects
- installation effects (e.g. wing shielding)
- flight effects on noise sources (e.g. Doppler amplification)

Flight effects modify the source strength. So it is possible to consider the impact of flight effects on noise sources in the frequency domain also within a sound simulator for audible sounds. For effects occurring on the propagation paths, like Doppler shift and ground reflection, phase information is important. These effects must be therefore simulated in the time domain.

For the sake of simplicity all effects occurring along the propagation paths have been treated in the time domain assuming a simple point to point propagation. In a 1st step the direct path is modelled, by considering the distance and Doppler effect. The Doppler effect can be considered by retarded time, i.e. a nonlinear transformation of time from emission to arrival at the receiver point must be carried out:

$$t_i = \tau_i + r_i/c \quad (4)$$

In this expression, t_i is the arrival time for the trajectory point i , r_i is the distance from the source to the receiver, τ_i is the retarded time and c is the sound speed.

The nonlinear transformation of time is done by interpolation and re-sampling of the sampled audio data. Atmospheric absorption is also considered in the time domain by applying time varying filtering on the audio data. Due to atmospheric absorption higher frequencies are significantly damped in particular for large distance of the source³. Other atmospheric effects like wind and turbulence are currently not taken into account. In a final step ground reflection is modelled. The basic principle is illustrated in figure 4.

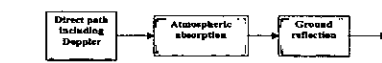


Figure 4: Modeling of propagation path

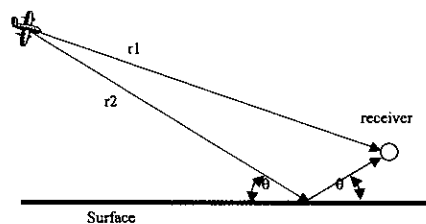


Figure 5: Visualization of ground effect

Due to the ground surface between source and receiver, sound is reflected against the ground and is thereby affected by a complex impedance. This leads to interference phenomena with the direct sound path at the receiver. The phenomena can be described analytically for single frequency analysis, provided that the ground impedance is known. In order to assess the mean effect on sound pressure level it is possible to use e.g. a statistical approach with an octave band or third octave band frequency bandwidth as usually done for aircraft noise prediction. For simple geometries like flat terrain, the two paths (r_2 , r_1 , see figure 5) can be treated independent and superimposed. In the path r_2 the magnitude and phase change due to reflection can be approximated by a filter. The required filter characteristic can be calculated from the Weyl-Van der Pol equation⁴:

$$P = P_D + P_R$$

$$P_D = \frac{e^{-ikr_1}}{kr_1}$$

$$P_R = [R_p + F(1-R_p)] \frac{r_1}{r_2} e^{-ik(r_2-r_1)} P_D$$

k is the wave number, $R_p(\omega)$ is the reflection coefficient, Z is the ground impedance, $F(\omega)$ accounts for ground waves relevant for Θ near zero (mathematically complex error function of "numerical distance").

An example for the required filter characteristic is shown in figure 7. The required filter characteristic depends on the aircraft position versus the receiver. This means that the filter characteristic must be changed permanently during the simulation of a flight. In addition to the reflection filter a time delay caused by the different path length (r_2-r_1) has to be taken into account as illustrated in figure 6. An example for the total effect of ground reflection on the perceived sound is shown in figure 8.

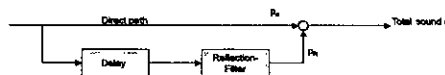


Figure 6: Simulation of ground reflection

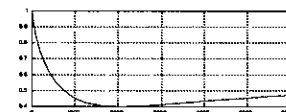


Figure 7: Magnitude and phase change due to reflection for flat terrain with grass (flow-resistivity $300 \cdot 10^{-4} \text{ Pa-s/m}$)

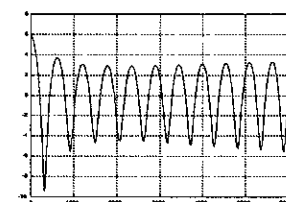
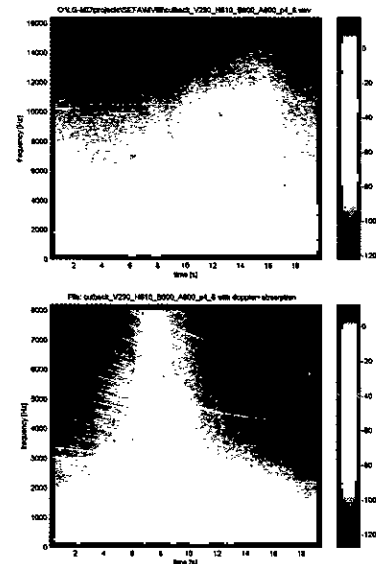


Figure 8: Simulated impact of ground reflection for flat terrain with grass (flow-resistivity $300 \cdot 10^{-4} \text{ Pa-s/m}$)

Tests synthesis of aircraft engine noise and in flight conditions

Synthesis of aircraft sound has been performed for several test cases related to certification measurements. In all cases the receiver is positioned at a height of 1.2m above ground. In a first step static engine noise has been synthesised considering the directivity according to varying view angle during flight path. After that the propagation effects as described in section 5 are applied. Changes of the sound for cutback condition are illustrated by the following waterfall diagrams showing the frequency spectrum versus time after each step of the simulation process.

Figure 9a shows the variation of source strength along the flight path due to directivity figure 9b illustrates how the sound changes due to direct path propagation. The sound is attenuated according to the distance of the source and the Doppler shift changes significantly the frequency, which becomes very obvious for tonal noise components. Figure 9c shows the impact of acoustic absorption on the sound.



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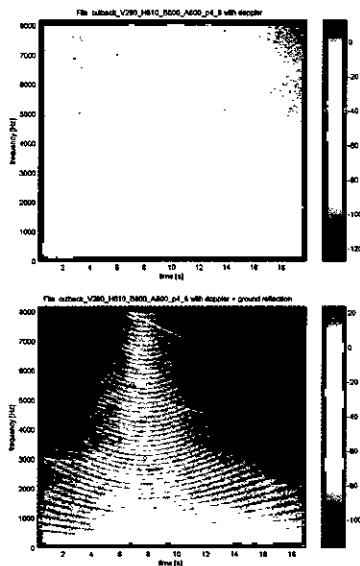


Figure 9:

- (a) Source strength including directivity along flight-path,
- (b) Uncalibrated sound pressure level at receiver due to direct path (without atmospheric absorption),
- (c) Uncalibrated sound pressure level at receiver due to direct path (including atmospheric absorption),
- (d) Uncalibrated sound pressure level at receiver including ground reflection

In particular for large distances (beginning and end of flight path) high frequency components are significantly reduced. All typical characteristics, which can be found in measured sounds for similar conditions are visible in figure 9d. In particular, it becomes clear that the interference pattern due to ground reflection have a very important impact on the perceived sound.

Conclusions

In this article, an original method for sound synthesis is presented. It is dedicated to aircraft noise modelling and specifically addresses the problem of aircraft noise disturbance. This method was built in the frame of SEFA European Project, which aims at developing a tool for the sound design of virtual aircraft. Two different synthesis methods are applied for tonal and broadband components, including accurate noise source decomposition. Then, by summing all components, time patterns synthesis of the noise sources is obtained including directivity along the real flight path. Afterwards, propagation effects are applied on the source time signal to achieve the final aircraft sound track as if measured at the ground.

The relevance of the approach was shown firstly through listening comparisons between static engine real measurements and

synthesised sounds and secondarily thanks to listenings of synthesised sounds simulating a flying aircraft.

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Quiet Personal Computers

Samuel Clarke.

As computer performance increases, so does the amount of noise generated. Computer manufacturers spend huge amounts of money developing the next generation of high performance computers, but apparently do not give much consideration to noise and vibration issues. As a result, quiet computers are becoming highly desirable, particularly for low noise environments such as recording studios and bedrooms.

There are now numerous products available, all stating that they will significantly reduce the amount of noise generated by the computer. This article investigates the effectiveness of different attenuation methods, and looks at some potential pitfalls of a quiet computer.

The quest for silence

Computers are commonplace in many bedrooms and living areas as they become more widely used for entertainment and music. The last thing anyone wants to hear during a period of suspenseful silence in a film is the whine of a cooling fan or the howl of a DVD drive.

Noisy computers in the workplace may influence productivity. Moreover, where computers are used for speech recognition a quiet computer can be shown to improve the accuracy of the software.

For the hardcore gamers the aim is all-out performance. The wish list is headed by high frame rates, smooth textures and fluid game play. It is these people who essentially drive the need for increased performance in computing. But performance comes at a cost — heat. The cheapest and most effective method for removing heat is airflow.

Data storage is another issue. Audio and video files take up large amounts of space. This has increased the need for fast hard-drives and high-speed optical media such as CDs and DVDs.

Manufacturers tend to focus on performance and stability, but pay very little attention to the issue of noise. One family of high-end graphics cards released last year was quickly dubbed 'dust-busters' because of the noisy cooling fans. Such mistakes can damage a manufacturer's reputation, particularly in the fickle world of computing.

Criteria

If computers are too noisy, just how much noise does an average example make? Preliminary measurements suggest that a level of between 40 and 50 dB(A) at a distance of 1m is typical. The WHO guidelines for sleep disturbance suggest that noise levels inside bedrooms should be lower than 30 dB(A), so it is not unlikely that computer noise would cause sleep disturbance.

A reasonable level target level might be 20 to 30 dB(A), although most users would prefer their computer to be essentially inaudible.

One drawback of a quiet computer is that noisier models often provide useful masking, where there otherwise may be none. For example, in an open-plan office environment where there is no air-conditioning, individual PCs can be the main noise source apart from human activity.

Sources of noise

Typically it is the moving parts within a computer that generate all the noise. Fans, hard-drives and optical drives all emit some noise in operation. The exception is the power supply transformer, which may hum or buzz a little. However, the cooling fans in the power supplies would typically mask the transformer noise, and it is only likely to be audible on passively-cooled power supplies.

Noise from fans is typically dominated by the noise of air passing over the fan itself. Fans with bearings rather than bushes may become noisy after time as the bearings become worn. A fan also has the potential to generate some vibration if poorly mounted.

Noise from hard-drives is often more of a vibration issue than a noise issue. Nevertheless, even a relatively quiet hard-drive can generate excessive noise if mounted poorly.

Noise from optical drives is often overlooked, since they only generate noise when they are in use. However, if a computer is to be used as an entertainment centre to listen to music or play DVDs, noise from optical drives may be a major concern.

Solutions

There are numerous products available designed to reduce computer noise. Most of them are not particularly cheap when compared with standard components.

For example, several different types of cooling fan are used in computers. The CPU will often have a dedicated cooling fan, as will most decent graphics cards. Most power supplies, unless passively cooled, have at least one cooling fan. Case fans are also commonplace on many computers.

The CPU fan can, in most cases, be removed completely if a high performance replacement heat sink is used. These heat sinks still rely on airflow from case fans in order to cool the processor effectively. They are often made of copper and many of the newer models also incorporate heat pipes, which makes them expensive at around £20 to £40 a unit. Fanless cooling solutions are also available for the replacement of fans on high-performance graphics cards.

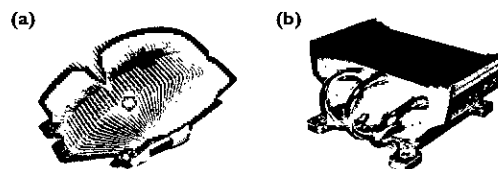


Figure 1: High performance heat sinks: (a) flower cooler and (b) heat pipe

As suggested above, hard-drives tend to be a major cause of vibration in a computer. One of the key improvements to hard-drives has been the introduction of fluid dynamic bearings, which reduce vibration considerably. Since noise from the hard-drive tends to be transmitted by its supporting structure, it can often be reduced by using isolation mounts.

There is very little that can be done in the 'after market' to reduce noise from optical drives. The best solution is to choose a quiet one when purchasing the computer in the first place.

Power supplies are often a dominant source of noise. Silent power supplies are available, and the quietest ones are passively cooled so there is no noise from cooling fans.

Small case fans can be replaced with larger fans which still achieve the same flow rate while running at lower speeds. Simple fan speed controllers are available which allow the speed of the fan to be adjusted manually. Many motherboards now have an integrated speed controller also. These vary the fan speed depending on system temperature. The disadvantage with thermal speed controllers is that the computer may be quiet when it is idling, but very noisy under load. Vibration from fans is also an issue, although gaskets and grommets can readily be used to isolate fans from cases.

Attenuators may be fitted to the case to reduce noise from cooling fans. These tend to be bulky and not particularly cheap, and flanking noise through cooling slots may also be an issue. Understandably, attenuators are not very popular.

If an owner values silence over performance he may choose to 'underclock' his computer, since this can significantly reduce the amount of heat generated and therefore reduce the amount of cooling required. Although this method sounds complicated, many new CPUs employ thermal throttling. Simply by reducing the fan speed manually, the CPU would underclock itself when it began to overheat.

Air is not a particularly efficient fluid for moving heat compared with water. Water-cooling allow huge amounts of heat to be removed quickly, but was once the domain of hardcore enthusiasts only. However, several products have been recently released which offer the benefits of water-cooling to mainstream users. A basic water-cooling kit consists of a

water block mounted directly to the heat source, a radiator to dump the heat, a pump to circulate water around the system, and silicon tubing to connect it all up. The systems tend to be very expensive because of the cost of individual components. Cooling fans may be required on the radiator, and noise from the pump may also be an issue. The threat of leaks is likely to deter most rational users.

There are several acoustic absorptive foam kits available for lining the inside of computer cases. These products reduce noise levels in two ways: firstly, reducing the reverberant noise level inside the case; secondly, dampening panel vibration by making panels more rigid. Unfortunately, foam kits tend to increase the temperature inside the case and as a result cooling fans may need to work harder, generating more noise than usual. Specially designed acoustic cases are another alternative, however they tend to be expensive. The example pictured costs almost £800 alone and weighs in at around 25kg.

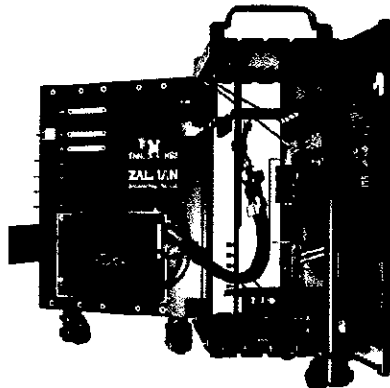


Figure 2: Acoustic case with in-built heat pipe cooling system

The ultimate solution is the purpose built silent computers which are now available off-the-shelf. These have limited potential for upgrading and are very expensive, costing around £1200 to £2000 just for the computer, with no screen, keyboard or mouse included.

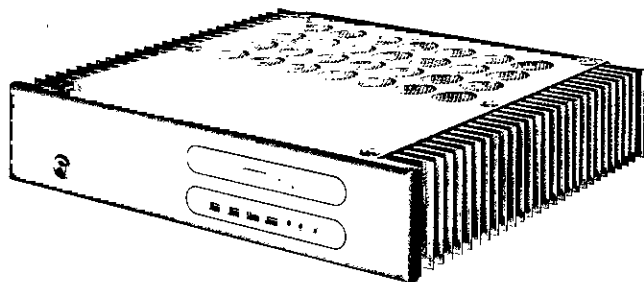


Figure 3: Hush™ ATX silent computer

Application: a shuttle PC

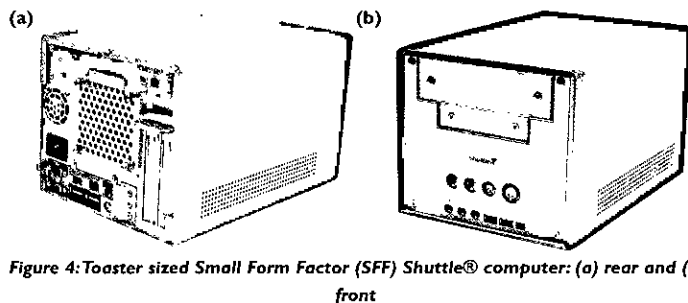


Figure 4: Toaster sized Small Form Factor (SFF) Shuttle® computer: (a) rear and (b) front

The author owns a small form factor shuttle PC. Given its relatively small size it sits on the desk approximately 400 to 500 mm from the nearest ear of a seated operator. The computer was found to be a little noisy at times, and attempts were made to reduce its noise emissions using off-the-shelf accessories.

The dominant noise sources were:

- power supply
- graphics card cooling fan

- case/CPU fan
- hard-drive
- optical drive

'Silent-X' power supply

The first port of call was the manufacturer's web site, where the release of an upgraded power supply named the 'Silent-X' was discovered. The manufacturer marketed the product as 'an amazing 250W ultra-silent PSU with high efficiency and high reliability'. Because there had been concerns that existing 200W power supply was not providing quite enough power to drive the memory, it was decided that even if the new PSU did not reduce noise levels significantly, at least it would increase the stability of the computer. The cost of the 'Silent-X' power supply was around £50.

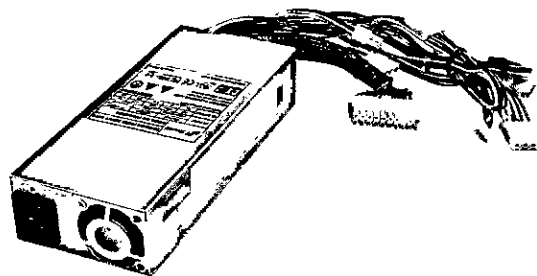


Figure 5: Silent-X power supply unit

During installation it was noticed that the new power supply had two cooling fans, whereas the stock power supply only had one. Noise levels emitted by the computer in its stock form, then with the new power supply installed, were measured. Interestingly, the computer was around 1 to 2 dB noisier with the 'Silent-X' power supply installed. Subjectively, a little more of a low frequency hum had become audible. The power supply upgrade was not a successful noise reduction measure.

Graphics card cooling fan

The loudest noise source in the PC case was the fan on the graphics card. However, the fan only seemed to run when the graphics card was running in 3D mode. Since most of the applications normally run on the computer were 2D, this was not regarded as a significant problem.

Case/CPU fan

The shuttle was an interesting design in that it used a heat pipe cooling solution in combination with a case fan to cool the CPU. This means that only one cooling fan was required. It was decided not to replace the case fan since the research had revealed that the existing fan was supposedly very quiet already.

'Smart Drive 2002C' hard-drive enclosure

Noise from the hard-drive was the next noise source on the list. There are only a couple of hard-drive enclosures on the market, and only one of these was suitable for this particular hard-drive because of the heat generated by its high operating speed. The Smart Drive 2002C is an aluminium case with copper linings to increase heat transfer. The inside of the enclosure is lined with dense spongy foam. The cost of the enclosure was around £40 plus shipping.

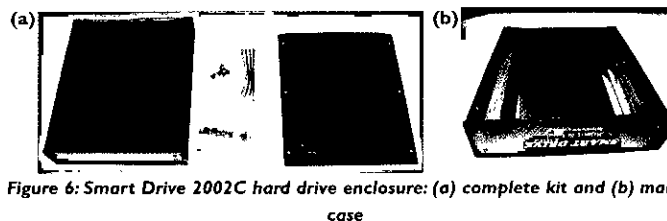


Figure 6: Smart Drive 2002C hard drive enclosure: (a) complete kit and (b) main case

The improvement from the enclosure was around 1 to 2 dB. Although the measured improvement was not great, subjectively the reduction in hard-drive noise was quite impressive. The hard-drive was still audible, but there was a definite decrease in that hard-drive 'bubbling' sound.

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Quiet Personal Computers - continued from page 29

The small overall reduction points to other sources, such as the 'Silent-X' power supply, becoming dominant. It is also worth pointing out that the hard-drive was running under idle conditions during the test, so the noise reduction would have been much greater for a hard-drive intensive activity such as defragmentation.

Optical drive

To install the hard-drive enclosure into the case the optical drive had to be removed. It is intended that an external optical drive will be sourced at a later stage.

The future for quiet computers

Most of the current solutions for quietening computers are very expensive since they typically involve a retrofit of components. Many

manufacturers are beginning to wake up to the need for quieter computers, but there is still a long way to go. Noise needs to be considered at the design stage rather than as an afterthought. Hard-drives are a good example of considerate design, where manufacturers putting a good deal of development effort into noise and vibration issues.

Manufacturers will need to implement new technologies in order to keep noise levels down as performance increases. Active noise control is already being developed for use in controlling fan noise in computers.

Sam Clarke formerly worked with Marshall Day Acoustics, Christchurch, New Zealand, and is now with Lambert and Rehbein, Fortitude Valley, Queensland, Australia (e-mail samuel.c@lar.net.au). This article is based on one which appeared in the September 2005 issue of New Zealand Acoustics, whose permission to use it is gratefully acknowledged.

Profiting From Change

Peter Hepworth BSc MIOA. The growth of Hepworth Acoustics Ltd.

Peter Hepworth gives a glimpse behind the scenes of this increasingly successful acoustics consultancy.

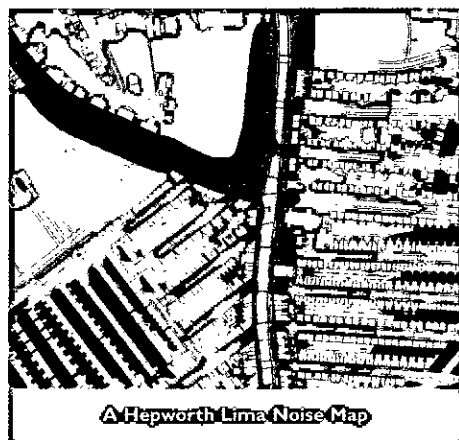
The heat was intense in an entirely enjoyable way. I sat in the shade watching the sun reflect off the Mediterranean as I kept an eye on the sound level meter and made notes for the survey of road traffic noise in a British army base in Cyprus. Not, I felt, an unpleasant life, and not what I expected when I had first set up my own independent acoustics consultancy. That had been in 1990, and my first office had been in the spare back bedroom of my home. That time working in Cyprus is now over ten years ago, the company has grown considerably since then, and the range of work we undertake is even more diverse.

To some extent, the history of Hepworth Acoustics reflects the changes in aim and emphasis of UK government and EU noise management and environmental legislation over the last 15 years. When I first founded the firm in January 1990, it was still the era of British Coal, and we were initially involved in a large number of public inquiries relating to opencast mining sites. Not so long after that, British Coal was privatised and our involvement in many of the opencast schemes came to an end as the new owner decided to use their own consultants. The focus for Hepworth Acoustics moved from mining to highways, with, again, a lot of involvement in public inquiries. I developed a real enthusiasm for acting as an expert witness - the necessity for solid preparation, the requirement for accuracy, the need to appear 'cool under fire' - an enthusiasm I have retained to this day. The involvement with highways schemes in a variety of capacities continued until the mid-1990s, when the UK government policy changed, and Hepworth Acoustics found the emphasis of work shifting as we became much more involved in acoustics projects related to the leisure industry. We were commissioned as the acoustics consultants on hundreds of themed bar and pub developments from Aberdeen to Plymouth. This was the time when,

as we shall see presently, the business began to expand significantly and to acquire the profile which it has today.

Government initiatives, of course, never cease, and two pieces of recent legislation have had a clear influence on the direction the company has taken. In terms of UK legislation, the new sound insulation testing regime which came on stream as a result of changes to the Building Regulations in 2003 has meant that a greater number of our clients are now developers and house builders. In order to deal with this workload, the company has a number of sound insulation testers who have been approved under the Association of Noise Consultants' Registration Scheme.

The European Directive on Environmental Noise has also had a marked effect on the kind of work undertaken by Hepworth Acoustics since 2000. The deadline set by the European Noise Directive, requiring the first noise maps by 2007, has meant that a number of large contracts have recently been awarded for noise mapping work, and there is still much work to be carried out before the deadline. This current workload has built on the experience gained from our first major involvement with noise mapping in 2002, when we carried out the development of a road traffic noise map for Westminster City Council.



The number of people employed in the company has increased significantly since those back-bedroom days of 1990. Indeed, they started growing almost immediately - after a few months of working 16 hours a day doing noise surveys, reports and all the company administration, and with more work still coming in, I became convinced that the company needed to expand. In autumn 1990, Hepworth Acoustics took on its first employee. From then on, throughout the nineties, the business took on roughly one new employee every year. We also opened more offices. The first move into offices was to Runcorn, followed by a move in to Warrington in 1994. Then, in 1998, we opened an office in Sheffield: at that time, it was staffed by one consultant, but soon there will be a team of five staff working there. In the same year, we opened an office in the south-east. Originally this office was situated in Horsham. Now it has split in two, with one office in Ashford in Kent and another in central London. In the early summer of 2005, we opened an office in Birmingham, followed in December by a branch in Bristol. It is part of the Hepworth ethos that all of our offices work together as a team, sharing the workload when things get particularly hectic, and supporting each other where particular specialisations are called for. This ethos is supported by a sophisticated IT system that allows consultants to access all information within the company, no matter where they are located. The IT infrastructure will also readily accommodate the further branches in the UK that are planned in the near future.

This extended network of offices and employees did not even appear to me a remote possibility when I started on my degree in Environmental Studies at the University of Sunderland (in its earlier incarnation as Sunderland Polytechnic). It was in my final year that the acoustics bug began to bite. A module on acoustics was a requirement of the course, and I thought, "Hmm, this is really very interesting." My degree was coming to an end, the world of employment was beckoning (or looming...) and it seemed natural to look for a job in acoustics. My first employment was as a noise technician with a local authority. I consolidated my understanding of the field through postgraduate studies, and continued working for local authorities for the next six years. After that time, I began to feel slightly restive, not because I did not enjoy working in local government, but because, necessarily, I always seemed to be telling people that they had a problem. By and large, local authorities are involved when something has become a problem, or is threatening to become a problem. I wanted to do something a bit more pro-active, and provide solutions rather than tell people that they have problems. I therefore left local government and joined an independent consultancy, where I spent five very happy years before, after long consideration, I felt I was ready to set up on my own. I cleared the back bedroom and Hepworth Acoustics was born.

There are now two main sections within Hepworth Acoustics, and a huge diversity of work undertaken. The consultancy section

continues to provide the bulk of our core business and is concerned particularly with environmental and building acoustics issues of all kinds, from highways to factories to schools to residential to nightclubs. The work is not all problem-solving either: it is refreshing to work on projects where the end result of the acoustic design will be an enhanced acoustic experience rather than the avoidance of a problem. We continue to provide expert witness support to clients at public inquiries, as, for instance, at the inquiry into the Worthing-Lancing by-pass - an inquiry which required two members of staff to be present for almost a year. I am also delighted with the way in which we are increasingly becoming involved in projects early on in the development stage, fulfilling my desire when I left local government of moving from fault-finding to problem-solving. A case in point is the recent work which Hepworth Acoustics has carried out with Living Ventures, owner and operator of The Living Room group of restaurants. We have carried out the acoustics consultancy work on all of the new developments carried out by Living Ventures. One particular project I have in mind that demonstrates the problem solving aspect of our work is the development of the York location. This is a 165-seat restaurant, 250-capacity bar, with live music, in the new Merchant Exchange development by the riverside, next to the Ouse Bridge, and directly below several storeys of loft-type apartments. The acoustic design, therefore, had to be capable of meeting the requirements of the planning consent and of providing sufficient

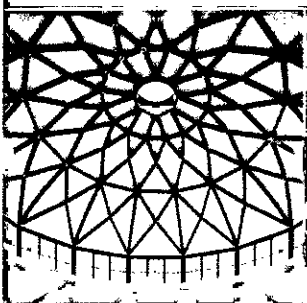
soundproofing to avoid noise complaints from the residents. Working closely with the architect, developer and contractor, we were able to ensure that the design specification was followed closely throughout. The result is one with which Jeremy Roberts, Living Ventures Commercial Director, is delighted. "The success of York speaks for itself," he has said. "We've been open for more than a year now with no complaints and have enjoyed a consistently positive relationship with our immediate neighbours." The benefits of building in acoustic design from the beginning make good business sense.

continued on page 32



The Living Room, York

We Listen - and now have a range of products to meet your performance and aesthetic criteria



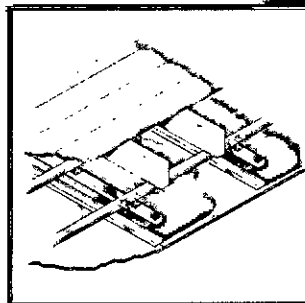
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Profiting From Change - continued from page 31

Based on a wide range of projects and jobs like these, the consultancy side of the business continues to thrive and grow.

There is another side to Hepworth Acoustics, though, and that is the noise mapping division. Hepworth Acoustics has always been interested in using the best of whatever was available in noise prediction software packages, with varying degrees of satisfaction. In 1996, however, we were attending an InterNoise meeting in Liverpool, where we encountered the LIMA software. We were soon in conversation with its developers, and consequently Hepworth Acoustics became involved in marketing the LIMA software in the UK until 2002. We continue to use the LIMA software for a variety of projects. The software is extremely effective when dealing with highway schemes or looking at industrial developments, and we use it daily for these and other areas of potential noise impact. The main function for which it was developed, however, and its primary use for us, is in the area of noise mapping.

I have already briefly mentioned the noise map that was carried out of Westminster City Council's area. Now, with the first deadline of the European Community's Environmental Noise Directive approaching, Hepworth

Acoustics are currently involved in three of the Noise Mapping England projects. We see this as being an important and growing aspect of the company's work. To this end we have substantially increased our noise mapping team, together with the necessary software and hardware, and are investing in research on noise-mapping issues.

The Environmental Noise Directive is a huge undertaking, with enormous repercussions for the acoustics industry. As from 2007, noise maps will be required for all urban areas with over 250,000 inhabitants, as well as for all areas close to major roads, railways and airports. From these noise maps, noise action plans to attenuate noise levels will need to have been drawn up and put in place by July 2008. Following on from this, by June 2012, noise maps must be produced for all urban areas with over 100,000 inhabitants, with concomitant action plans to be in place by July of the following year. These noise maps are being created all over Europe, in every EU member state, but it is in the UK that the effect is likely to be felt most markedly, given the density of population. Once the noise maps have been drawn up, and the action plans carried out, the UK should be a significantly quieter place. It is a great privilege that Hepworth Acoustics is playing its part in that process.

The company has come a long way since its inception some fifteen years ago. We now have six offices covering most of England. We have expert personnel who are specialists in their fields, ranging from building acoustics to noise mapping software. We have worked on projects from the north of Scotland to the south-west tip of Cornwall, from the west coast of Wales to East Anglia, as well as in Northern Ireland and the Irish Republic, and we are increasingly undertaking work in Europe. In fact, we have been involved in a project measuring noise from a gas pumping station during the night in Poland in the middle of winter. Not entirely by chance, I was too busy to carry out that survey personally...

The future is increasingly bright for the acoustics industry, as environmental issues take on an ever more central role in governmental, transnational and global policies. Hepworth Acoustics looks forward to developing its expertise in all aspects of acoustic design and noise management, and making its contribution towards the creation of environments in which noise nuisance is held to a minimum, and in which you could, on occasions, hear a pin drop.

Peter Hepworth is Managing Director of Hepworth Acoustics Ltd.

Pioneers of Acoustics - Valdemar Poulsen (1869-1942)

JW Tyler FIOA profiles the inventor of magnetic recording and the arc transmitter



Valdemar Poulsen (left) with Peder Olaf Pederson

The Inventions

On 1 November 1898, Poulsen filed a patent in Denmark for the Telegraphone (or in Danish, Telegrafoon), the first device in history to use magnetic sound recording. An extract from this patent reads:

"The invention based upon the fact that when a body made of magnetisable material is touched at different points and at different times by an electromagnet included in a telephonic or telegraphic circuit, its parts are subject to such varied magnetic influences that conversely by the action of the magnetisable body upon the electromagnet the same sounds or signals are subsequently given out in the telephone or recording instrument as those which previously caused the magnetic action upon the magnetisable body"

Perhaps a present day description might be somewhat clearer in meaning but the fact remains that Valdemar Poulsen invented the first magnetic recording device. He also invented the Poulsen arc transmitter - the first device for generating continuous radio waves, thus aiding the development of radio broadcasting.

The Man

Valdemar Poulsen was born in Copenhagen on 23 November 1869, the son of a Danish High Court judge. It is recorded that Valdemar was not a good scholar showing interest in only physics and drawing. He had no interest in mathematics, a trait he shared with many other great inventors.

His father wanted him to become a doctor and he made an effort to please his father by attending medical school at the University of Copenhagen. This proved unsuccessful and he left university at the age of 24 for a position in the technical section of the Copenhagen Telephone Company. While working there, Poulsen became interested in the magnetic recording of sound on steel wire. It is not known for certain what gave him the idea but it was possible that he had read an article written in 1888 by the American scientist Oberlin Smith for the magazine *Electrical World*. In his article Smith had discussed the possibility of permanent magnetic impressions for recording sound and suggested, as a medium, cotton or silk thread in which steel dust was suspended. He also

considered steel wire but did not think it would be possible 'that it would divide itself up properly into a number of short magnets' to establish a magnetic pattern as a replica of currents produced by a microphone. Smith never built a machine or proved his theories practically.

In an early experiment Poulsen stretched a slightly sloping steel wire across his laboratory, and put the recording apparatus (a small electromagnet with a microphone and battery) on a trolley that travelled along the wire under the influence of gravity. He would run along with the moving trolley, talking into its microphone to record sound on the wire (this does give rise to a comical mental picture!). To play back this sound he would roll a second trolley down the wire with a telephone earpiece attached to it. This did reproduce the speech sounds and Poulsen set about putting his invention to use in the form of a telephone recording machine, the above mentioned Telegraphone.

The Telegraphone

Poulsen's first machine, the Telegraphone, consisted of a spirally grooved brass cylinder around which, embedded in the groove, was wound a 0.01in diameter steel wire. The two poles of an electromagnet, energised by the output of a microphone were held close to the wire. The cylinder rotated while the electromagnet was traversed across the cylinder. Playback was achieved by replacing the microphone by a

telephone earpiece and traversing the cylinder as before. The Telegraphone recorded continuously for 30 minutes on the steel wire at a speed of 84 inches per second. An interesting description of Poulsen's invention by an American technical author of the time is reproduced here.

Reports by those who heard the original design remarked on the "naturalness of the reproduction" and the "freedom from noise". These remarks were of course based on comparisons with the acoustically recorded phonograph cylinders of the period. However the volume level was very low as no means of electrical amplification was then available; this had to wait for the invention of the vacuum tube or valve. The Telegraphone received considerable attention when it was exhibited at the Exposition Universelle in Paris in 1900. The Austrian emperor Francis Joseph spoke a few words into it at the Exhibition and this recording is believed to be the earliest surviving magnetic recording. Valdemar Poulsen received the Grand Prix of Paris for his invention but even with this encouragement he could not find financial backers in Europe.

Poulsen continued his work on magnetic recording with his associate Peder Olaf Pederson, a talented engineer, and developed an improved version of the Telegraphone using reel to reel wire but was dispirited by the lack of commercial success (only a small number of his machines were made in Denmark and Germany) and turned to research on radio after 1902. Poulsen saw his new invention come to fruition with The American Telegraphone Company who acquired the patent rights in 1905

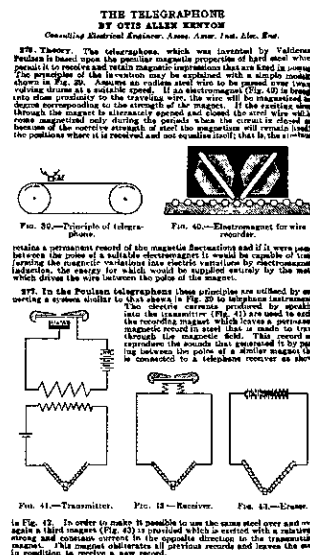
and made dictating machines, selling 50 to the Du Pont Company. The company manufactured the Telegraphones in the form of reel-to-reel wire recorders for use as telephone answering machines and dictating machines. However, the signal remained weak without amplification and the wire spools became twisted and were unreliable. The wax cylinder phonographs of the rival Ediphone and Dictaphone companies were cheaper and more reliable. By 1918, the company went into receivership and it stopped manufacturing after 1924.

In 1927 American inventor J A O'Neil replaced the wire with a magnetically coated ribbon and since then magnetic tape recorders have dominated the recording industry.

The idea of recording sound magnetically would appear to be Poulsen's alone as nobody else has ever claimed credit for the invention, unlike the situation with most other electrical devices such as the telephone, phonograph, cinema, sound-on-film and television. He also must have thought ahead of the possible developments of his invention; in present day descriptions, tape recording, hard disk, floppy disk, credit cards and train tickets; as the following extract from his 1899 UK Patent No: 8961 shows. "Instead of a cylinder with a helical steel wire there may be used as a receiving device a steel band, supported if necessary on an insulating material and brought under the action of an electromagnet. Such an arrangement has the advantage that a steel band of a desired length may be used. Instead of a cylinder there may be used a disk of magnetisable material over which the electromagnet may be

conducted spirally; or a sheet or strip of some insulating material such as paper may be covered with a magnetisable metallic dust and may be used as the magnetisable surface. With the aid of such a strip which may be folded, a message received at any place provided with the new apparatus may be sent to another place where it may be repeated by passing the strip through the apparatus at that place".

Although Poulsen patented his invention worldwide his attempts to do so in the USA caused him some problems (see below).



continued on page 34

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Valdemar Poulsen - continued from page 33

In 1928, a German engineer, Fritz Pfeumer, demonstrated to journalists in Berlin a magnetic recorder of his own design which used paper tape coated with steel dust. He was granted a German patent for his invention. In 1932 AEG took up his idea and began the manufacture of the machine calling it the Magnetophon while (what was later to become) BASF produced the tape. In 1936 the German National Court declared Pfeumer's patent was null and void because his idea of coating paper tape with iron dust was covered in Poulsen's original patents of 1898 and 1899. Thus Valdemar Poulsen was vindicated as the inventor of all magnetic recording.

The American experience

In 1899, the US Patent Office received an application from Valdemar Poulsen for his Telegraphone but the omens were not good. Unfortunately for him, the Patent Office felt that his invention was contrary to all known laws of magnetism. They wanted him to supply a working model (a requirement which had been abandoned in 1880) and to come over himself to demonstrate it. His lawyer argued that this would be prohibitively expensive and a compromise was worked out where he would demonstrate it in Europe and officials there would testify to its success. This was done to everyone's satisfaction, and the patent office yielded and granted him a patent on his method. However, at first no one had noticed that Poulsen's American application was filed one week late - exceeding the seven-month limitation on non-U.S. citizens. The patent could not be rescinded, but it would have no legal value. Luckily, Poulsen was able to institute action in the US Congress, partly blaming a clerk in his lawyer's employ and an Examiner in the Patent Office, and a Bill for the Relief of Valdemar Poulsen was passed in 1903 - a rare event!

Poulsen continued to work on his device for years with engineer Peder Olaf Pederson, but even with the development of the vacuum tube, which made electrical amplification possible, the invention never produced a profit during its seventeen years of patent protection. The history of the Telegraphone is a reminder that a patent is not a guarantee that a wonderful idea will be quickly adopted.

The Poulsen Arc Transmitter

Until the invention of the Poulsen arc, the only means of wireless telegraphy had been spark transmitters which had serious and inevitable flaws. They were "dirty" transmitters since they emitted strongly damped radio waves, which, by their nature had a broad frequency spectrum. Thus they

could not be sharply tuned and nearby radio stations interfered with each other. Another problem was that the damped waves, being intermittent could not be modulated to carry continuous audio signals; that is, wireless telephony. After many attempts to solve these problems within the spark concept, scientists and engineers realised that the only satisfactory solution was to use continuous radio waves. These, at that stage of electrical engineering, were very difficult to produce, requiring rapidly rotating alternating current generators. However the very high rotating speeds required caused considerable mechanical difficulties.

Enter Valdemar Poulsen who invented the first high frequency generator without moving parts.

To give some background to Poulsen's work due credit must be given to another researcher, the Englishman William Duddell, who, a few years before had produced the "musical arc", an electric oscillator made from an arc lamp shunted by a condenser (capacitor) and a coil to form a tuned resonant circuit. This device produced sounds in the audible range determined by the value of the reactive components. Duddell had proposed that the arc might be used as a generator for continuous radio waves but his experiments in 1903 showed that the arc could not operate at frequencies more than about 100kHz, too low for radio work. At this time Poulsen, experienced as a telephone engineer with the Copenhagen Telephone Company, became interested in wireless communication, and having heard of Duddell's work, started experiments with electrical arcs. He tried out many different modifications of the singing arc and discovered that letting the arc burn in the vapour of a spirit lamp could increase the frequency. He later jokingly claimed he had been inspired by the stimulating effect of alcohol!

After many experiments he confirmed that it was important to let the arc burn in an atmosphere of hydrocarbon vapour or pure hydrogen and also that a magnetic field perpendicular to the arc helped to increase the frequency and efficiency of the oscillations. During the two years following the invention in 1902, Poulsen patented the arc generator in Denmark and 13 other countries. Because the arc generator was so different in principle to what had gone before in radio technology, Poulsen and Pederson had to develop a new type of detector, the so-called "tikker" to utilise the continuous waves.

When they did this in the summer of 1904 they succeeded in establishing a radio link between the laboratory in Copenhagen and an experimental radio station in Lyngby, 15 kilometres distant from Copenhagen, and in less than two years later they crossed

Denmark by wireless, connecting Lyngby to Esbjerg, 270 kilometres away.

However Poulsen and Pederson did not have much success in interesting Scandinavian telegraphy companies in investing in the new technology so they approached investors in England and in July 1906 they signed a contract with Lord Armstrong and others who owned the British De Forest Wireless Telegraph Syndicate. The agreement joined the Danish and British interests into a new company, the Amalgamated Radio Telegraph Company. Poulsen and Pederson soon displayed the superior properties of the arc transmitter when, within a year, they managed to establish experimental wireless connections from Denmark to Cullercoats, Newcastle (about 1500km). But the enterprise was brought to a sudden halt when Lord Armstrong went bankrupt.

Eventually Danish investors established a new, all Danish company, the Continental Syndicate, which became the organisational basis for Poulsen and Pederson's work during the following years. World War I stimulated the development of the arc after the American Federal Telegraph Company, specialising in arc transmitters, brought Poulsen's arc to America. Arc transmitters up to 500kW were tested by the USA Navy. One disadvantage of the arc was that it transmitted harmonics and arc mush and the heat generated was so great that a water cooling system was required. Nevertheless a number of WWI battleships carried arc transmitters, and the Poulsen system achieved international recognition, helped by a rapid development in the United States. Later, The USS George Washington, which took President Wilson to the Peace Conference, was equipped with an arc in the hope that communication might be maintained all the way across the sea. It was a triumph for radio when the Washington, entering the harbour at Brest flashed signals from its arc which were picked up at Otter Cliffs, Bar Harbor, Maine and a 600 word message was received without the loss of a word.

Poulsen's work and that of later pioneers made long wave radio broadcasting possible by 1920.

Valdemar Poulsen died in July 1942. Not much appears to be known about his private life, but he was well respected by the scientific community and held the Gold Medal of the Royal Danish Society of Science and the Danish Government Medal of Merit. He was also a Fellow of the Danish Academy of Technical Science and the Swedish Institute for Engineering Research and he held an Honorary Doctoral degree from the University of Leipzig; not bad for someone who left medical school without graduating.

From Hansard

Commons written answers

Civil aircraft noise: 20 October 2005

Mr Lidington: To ask the Secretary of State for Transport what his policy is on the monitoring of the compliance of civil aircraft noise levels with international noise certification standards.

Ms Buck: Aircraft operating into the UK have to comply with noise standards agreed through the International Civil Aviation Organisation. Compliance for those aircraft on the UK register will be verified by the Civil Aviation Authority; for non-UK aircraft it will be by the state of registry. Airports may seek information from airlines on the noise certification status of aircraft in the event of uncertainty.

A38 roadworks: 27 October 2005

Mr Streeter: To ask the Secretary of State for Transport whether the roadworks to the A38 are being carried out on a 24-hour a day basis; and if he will make a statement.

Dr Ladyman: The Highways Agency has explored every opportunity to reduce the length of time it will take to carry out the roadworks on the A38 between Ashburton and Buckfastleigh in Devon. Together with local authority environmental health officers, the agency has carefully considered the possibility of 24 hour working but this was rejected because of the effects of noise on local residents. Planning conditions to control noise also apply to the operation of the quarry that is being used to provide materials for the work.

Hearing loss: 2 November 2005

Mr Davey: To ask the Secretary of State for Defence what (a) medical and (b) scientific research Department has (i) commissioned and (ii) evaluated to support the use of 50 decibels as the threshold for veterans claiming compensation for noise-induced sensorineural hearing loss as a result of their military service.

Mr Touhig: Neither the Ministry of Defence, which is responsible for veterans matters, nor the former Department of Social Security, which was responsible for the War Pensions Scheme until 2001 and remains responsible for the related civilian Industrial Injuries Scheme, have commissioned medical or scientific research on this issue. However, the Government's approach to noise-induced sensorineural hearing loss assessment is based on contemporary scientific evidence and understanding. This has been confirmed in recent years by several reviews carried out by independent audiological experts including the Industrial Injuries Advisory Council which confirmed the appropriateness of the threshold in November 2002.

Stansted Airport (noise pollution): 2 November 2005

Mr Newmark: To ask the Secretary of State for

Transport what steps he is taking to reduce noise pollution from Stansted airport; and if he will make a statement.

Ms Buck: The Government have a two-strand approach to tackling the problem. The first strand is to seek reductions of noise at source through international negotiation and agreement, implemented by national regulation. The second strand is to provide for controls on operational noise and the mitigation of its worst effects. Stansted is designated for the purposes of section 78 of the Civil Aviation Act 1982, making the Secretary of State directly responsible for those controls.

The 2004 annual noise exposure contours for Stansted were published in August 2005 and are on the Department's website at www.dft.gov.uk together with ERCD Report 0503 which provides data on the areas and populations within the contours and comparisons with earlier years. Between 1988 and 1998 areas and populations within the contours generally rose in line with movements but in 1999, despite the high traffic growth, the area within the 57 dBA Leq contour fell by 19 per cent. and this improvement has been maintained so far despite further significant growth in traffic.

Noise pollution: 7 November 2005

Annette Brooke: To ask the Secretary of State for Transport what representations he has received regarding noise pollution from cars fitted with double exhausts; and what discussions he has had with manufacturers on this.

Ms Buck: The answer to both points is none. Since 1996, the noise limit for all new passenger cars registered for on-road use in the European Union has been 74 dB(A). This limit applies to all cars, regardless of the type of exhaust system fitted.

Noise-induced hearing loss: 10 November 2005

Mike Penning: To ask the Secretary of State for Defence whether his Department keeps a record of hearing tests carried out on service and ex-service personnel and their results.

Mr Touhig: Records of hearing tests and their results are held as part of an individual's personal medical record. The medical records of serving personnel are held at their unit medical centre, whereas the medical records of individuals who have left the services are held by each service at individual central locations. The Ministry of Defence does not, however, hold records of hearing tests which take place after an individual has left the services. The MOD does not hold a central database of hearing test results.

Mike Penning: To ask the Secretary of State for Defence how much was spent on (a) war disablement pensions and (b) Armed Forces Compensation Scheme payments for noise-induced hearing loss, in each year since 1990.

Mr Touhig: War pensions are not awarded for individual conditions, but for the total degree of disablement due to service, assessed on a percentage basis. This overall assessment takes account of all conditions that are attributable to or aggravated by service. We cannot therefore separately identify amounts paid in respect of

one particular condition. The information requested is not therefore available for war disablement pensions.

The Armed Forces Compensation Scheme only applies to injuries or illnesses caused on or after 6 April 2005, and there have been no awards made for noise-induced hearing loss under the Scheme since it came into force.

Mike Penning: To ask the Secretary of State for Defence how many people are in receipt of a war disablement pension for noise-induced hearing loss.

Mr Touhig: A war pension is awarded based on the overall percentage disablement due to service of an individual, not on particular medical conditions. Our war pensions database indicates that there were approximately 80,000 people entitled to an on-going payment under the War Pensions Scheme at 30 June 2005 who had had a claim accepted for noise induced hearing loss. In about half of these cases, there were no claims for any other medical conditions recorded.

Motorways: 21 November 2005

Mr Lidington: To ask the Secretary of State for Transport how many miles of motorway in England have been resurfaced across their entire width with a noise suppressing surface.

Dr Ladyman: The motorway network comprises 3,593 miles of two and three lane carriageway, of which 680 miles has been resurfaced with quieter surfacing across all respective carriageway lanes.

The Highways Agency does not record motorway carriageway data on a route basis. The motorway and trunk road network is managed on the basis of the two individual carriageways that comprise a motorway route (ie one carriageway in each direction); information for a complete width of motorway along a prescribed route cannot therefore be readily reported.

Mr Paul Goodman: To ask the Secretary of State for Transport how many kilometres of motorway received quiet surfacing in all lanes in (a) 2004, (b) 2003 and (c) 2002; and what percentage of the highway network each figure represents.

Dr Ladyman: Motorway carriageway lengths that were resurfaced with quieter surfacing in all lanes and in both directions in each of the identified years, together with the associated percentage of the motorway network are shown in the table:

	Carriageway length (km)	% of motorway network
2002	146	2.5
2003	241	4.2
2004	97	1.7

Mr Lidington: To ask the Secretary of State for Transport if he will list the stretches of the M40 across which all lanes have been resurfaced with a noise suppressing surface; and what the length of the stretch involved is in each case.

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Hansard - continued from page 35

Dr Ladyman: The lengths of M40 motorway that have surfacing with noise reducing properties across all running lanes (not including the hard shoulder) amount to 67km of three-lane road in 47 sections. A detailed table is given.

Veterans (noise-induced hearing loss): 21 November

Mr Kemp: To ask the Secretary of State for Health what medical and scientific research her Department has commissioned to support the use of 50 decibels as the threshold for veterans claiming compensation for noise-induced hearing loss as a result of their military service; and if she will re-assess this threshold.

Mr Touhig: I have been asked to reply. Neither the Ministry of Defence, which is responsible for veterans' matters, nor the former Department of Social Security, which was responsible for the War Pensions Scheme until 2001 and remains responsible for the related civilian Industrial Injuries Scheme, have commissioned medical or scientific research on this issue. However, the Government's approach to noise-induced sensorineural hearing loss assessment is based on contemporary scientific evidence and understanding. This has been confirmed in recent years by several reviews carried out by independent audiological experts including an Industrial Injuries Advisory Council review which confirmed the appropriateness of the threshold in November 2002. Any change to our approach would need to result from further medical and scientific evidence.

Motorways: 24 November

Mr Paul Goodman: To ask the Secretary of State for Transport which environmental specialists he has consulted in relation to proposed limit values for environmental noise produced by motorways.

Dr Ladyman: No environmental specialists have been consulted on the environmental noise limit values specifically related to motorway noise as work has not yet commenced.

Mr Paul Goodman: To ask the Secretary of State for Transport what limit values for environmental noise produced by motorways have (a) been proposed and (b) are under consideration.

Dr Ladyman: No environmental noise limit values specifically related to motorway noise have been considered or are currently proposed. Consultations on legislation to implement the Environmental Noise Directive (2002/49/EC) are being undertaken by DEFRA. National guidance on intervention levels to be applied within the UK, for the purposes of prioritising actions under future noise action plans, as required by the Directive, is expected in July 2007.

Mr Paul Goodman: To ask the Secretary of State for Transport what assessment he has made of the effectiveness of noise reduction on sections of motorways when (a) all lanes are resurfaced and (b) some lanes are resurfaced; and if he will make a statement.

Dr Ladyman: Studies carried out on various parts of the strategic road network, including one motorway site, identified noise reductions in the range of 2-4dB(A) at properties in close proximity to the adjacent highway following the resurfacing of all carriageway lanes with quieter surfacing materials. No studies or assessments have been carried out at locations where only part of the carriageway has been resurfaced with such materials.

A417/419: 28 November 2005

Mr Clifton-Brown: To ask the Secretary of State for Transport (1) why the ministerial commitment to resurface noisy concrete surfaces in relation to the A417/419 Swindon to Gloucester road has been dropped; whether this was a uniform decision for all the roads listed in the original decision; and whether the Government will consider (a) new claims for blight from noise and (b) further remedial measures in relation to the A417/419;

(2) whether the A417/419 Swindon to Gloucester road will be resurfaced in the normal maintenance schedule; and whether the design, build, finance, operate provider will be responsible for the costs.

Dr Ladyman: Following detailed scrutiny of departmental and the Highways Agency's budgets, Ministers agreed that the resurfacing of roads ahead of a

maintenance need, for noise alleviation reasons, would not be allocated funding. This was a uniform decision across the entire motorway and trunk road network in England and is now the position up to 2007-08.

The Government cannot consider new claims for blight from noise as the noise assessments on which original blight claims were based, assumed a worst case and any noise insulation or compensation has already been provided on that basis.

While the Highways Agency will continue to consider remedial measures, these will have to take their turn in the regional priorities for trunk road improvement schemes.

The A417/A419 will be re-surfaced when maintenance need dictates and, if this is during the life of the DBFO contract, then the DBFO company will carry out the work and be responsible for the costs.

'Sound Bombs'

in Gaza

Israeli Air Force pilots have adopted the tactic of creating sonic booms low over the homes of Palestinian civilians. UN officials and doctors have described the practice as indiscriminate and terrifying. The 'sound bombs' cause widespread fear, induce miscarriages and traumatise children.

When Jewish settlers were evicted from the Gaza Strip it opened the way for the military to use jet aircraft to create dozens of sonic booms, often at night, by going into supersonic flight at low altitude, sending shockwaves across the territory. Palestinians say the experience is like an earthquake or a huge bomb. They report sensations such as being hit by a 'wall of air' that is painful on the ears, and sometimes causes nose bleeds leaving them 'shaking inside'. The Palestinian health ministry says the sonic booms have led to miscarriages and heart problems. The UN has demanded an end to the tactic, saying it causes panic attacks in children.

The shockwaves have also damaged buildings by cracking walls and smashing thousands of windows. One blew in the glass of the Chairman Arafat shop in Gaza City. The owner, Tareq Dayyeh, said that he had never heard such a loud explosion. He thought it was right over his building. He had sometimes heard the rockets the Israelis fired, but this was different. When he ran out of his front door he expected to find that the rest of the street had disappeared.

In a typical week, Israeli jets created between 25 and 30 sonic booms over the Gaza Strip, sometimes at hourly intervals through the night. The stated aim is to eliminate civilian support for armed Palestinian groups responsible for suicide bombings and mortar attacks. The government argues that sound bombs are preferable to real ones.

However, two medical human-rights groups, one Israeli and one Palestinian, have submitted a petition to the Tel Aviv high court demanding an end to the tactic, on the grounds that it is a breach of international law and detrimental to health. Eyad El Sarraj, a psychologist and director of the Gaza Community Mental Health Programme, one of the two groups, says that when the booms occur night after night it was exhausting. People experienced a heightened sense of alert, waiting continuously for it to happen. Many suffered hypertension, sleeplessness and fatigue.

The UN Palestinian refugee agency said that the majority of the patients seen at its clinics as a result of the sonic booms were less than 16 years old, and suffered from anxiety attacks, temporary loss of hearing, muscle spasms and breathing difficulties.

Although the Israelis say the shockwaves do not cause casualties, doctors at Gaza's Shifa hospital said the overflights had forced women to miscarry. The armed forces have had to apologise after sonic booms were unintentionally heard hundreds of kilometres inside Israel. It was described as sounding like a heavy bombardment, and thousands of citizens leapt in panic from their beds. Many of them made worried phone calls to the police and the fire brigade, and the Tel Aviv police switchboard crashed.

Long Range Acoustic Device

Deployed on luxury cruise liners

Passengers travelling on luxury cruise liners usually expect to be looked after by their ship's crew, but pirates who tried to hijack a liner off the coast of Somalia met something a little more sophisticated than a warning shot across the bow. The crew of the Seabourn Spirit quickly changed course and headed out into open water to evade attackers in small boats, who had raked the vessel with rockets and automatic weapons fire.

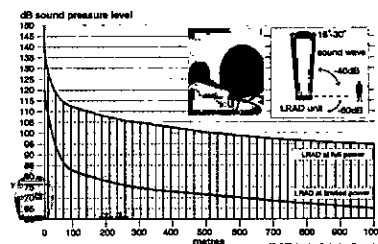


The crew also deployed a military-grade sonic weapon: the long range acoustic device, LRAD. This has been described as a very powerful loudhailer, and is capable of causing permanent damage to hearing from a distance of more than 300 metres.

It was commissioned and designed after the al-Qaeda attack on the USS Cole in Yemen in 2000. The American Technology Corporation (ATC) that manufactures it says the LRAD is a non-lethal weapon with a wide range of uses. It is typical of a new generation of weaponry being deployed in conflict zones, and was bought by the US Navy in 2003. The device is regularly used by US and UK forces aiming to prevent attacks on ports at the mouth of the Tigris in southern Iraq. US troops have also used the LRAD in action in the Iraqi cities of Falluja and Baghdad, and it was even used for crowd control in New Orleans in the wake of Hurricane Katrina.

The LRAD uses a high energy acoustic beam — a very loud noise — to disable and disorient a crowd or an assailant. The units are about 840mm across and weigh 20kg, and can be bought for around £18,000 each.

It is an increasingly popular optional extra on the world's cruise ships. ATC says that if one owns a \$1bn ship and can have the ability to make oneself understood at a distance, it is an option bound to be taken up. The manufacturer says the device can be used as a loudspeaker, enabling operators to be heard with authority above the din of a battle, whether in the desert or on the high seas.



While the effect on the pirates of Seabourn Spirit's deployment of the LRAD remains unclear, ATC boasts that it can also produce a 'warning tone that influences behaviour and determines intent at safe stand-off distances'. The shrill sound of an LRAD at its loudest sounds something like a domestic smoke alarm, but at a claimed 150dB, it can cause major hearing damage if misused.

Security is an increasing concern for tour operators entrusted with the safety of thousands of passengers each year, most of whom have dug deep for fees that are often more than £5000 a trip. Many of the security personnel on cruise ships are retired US and British naval officers. They seem to have decided that they can make effective use of the latest devices. The cruise sector was praised for being awake to the dangers posed by pirates and, possibly, terrorists. The security staff on board the Seabourn Spirit also won ATC's praise. The company trains all the crew to operate the device. This time the head of security was an ex-Gurkha from Nepal, and he made some good rapid decisions.

On full power, the device can emit a concentrated, 150dB acoustic wave, which retains a level of 100dB over distances of 500 metres. Most household smoke detectors emit about 85dB. The sound is focused within a 15 to 30 degree 'beam', allowing the LRAD to be aimed at a specific target. Persons standing next to the wave will experience 40dB less noise than those directly in its path. Those behind the LRAD unit benefit from a 60dB reduction in output.

Defra Announcement

Neighbourhood noise strategy

The Department for Environment, Food, and Rural Affairs (Defra) is preparing a Neighbourhood Noise Strategy that will be ready by the end of 2007. An important first step in developing this strategy is to examine how the existing methods of dealing with neighbourhood noise are put into practice.

Neighbourhood noise includes noise from all sources except transport and thus covers noise from industrial and commercial activity, recreation and entertainment noise, and noise from neighbours. If the local council's officers consider that noise from any of these sources is a 'statutory nuisance', they have powers that can result in the noise being reduced in level or controlled in other ways — eg only being permitted at specific times. Not every annoying noise is a 'statutory nuisance', however. There is no set noise level that determines whether a noise is classified as a statutory nuisance. As well as the level of the noise, the decision takes into account other factors including the time of day, how often the noise occurs, and how long it lasts.

The main powers of a local council to control noise are contained in the Environmental Protection Act 1990 (the EPA). Section 80 of the EPA sets out the circumstances in which the council is required to serve a Noise Abatement Notice on the person responsible for the noise. The Abatement Notice can specify what must be done to stop the nuisance and can include noise levels that must not be exceeded.

Defra has therefore let a research contract to review the use of S80 notices. The study will review, in conjunction with Local Authorities:

- the variation in the details specified in notices
- the different noise sources for which notices are used, and whether that affects the drafting of the notice
- if a notice is used, how the requirements included in it are determined
- how the decision is made to use a notice, or some other method of controlling the noise
- why some types notice are not used
- why some other enforcement options are not used
- what options are available if the noise, though a problem, is not considered to be a statutory nuisance

The study will then report on where improvements could be made to the current methods of using Noise Abatement Notices, suggest alternatives that could be used, and explain why they are not used at present.

Euronoise 2006

Conference announcement

The 6th European Conference on Noise Control will be held from 30 May to 1 June 2006 in Tampere, Finland. See www.euronoise2006.org. The conference is organised by the European Acoustics Association, the Acoustical Society of Finland and VTT (Technical Research Centre of Finland) with the cooperation of INCE/Europe. In addition to the main theme "ADVANCED SOLUTIONS FOR NOISE

CONTROL" the conference is open to all topics in noise control.

Abstracts should be submitted before 30 November 2005 by using the form on the web page.

Jean TOURET, INCE/Europe President

INCE/Europe is a not-for-profit organisation registered in England www.inceurope.org

HEVAC

New HEVAC 'Noise & Vibration Control Group' to benefit HVAC sector

The new 'Noise & Vibration Control Group' (NAVCOG), part of HEVAC in the Federation of Environmental Trade Associations (FETA), held its first meeting on 1 November.

It is believed to be the first time in many years that rival designers and manufacturers of noise attenuators have met together to address a range of industry issues.



Geoff Crowhurst, Divisional Director, Acoustics of IAC Ltd, Chairman of the Noise and Vibration Control Group (NAVCOG) within FETA

The new Group includes representatives from Conabeare Acoustics Ltd, EEC Ltd, Galloway, IAC, Isolated Systems Limited, Nendle Acoustics Co Ltd, Noico, Tek Ltd and HEVAC. The Group is chaired by Geoff Crowhurst, Acoustics Division Director of IAC, who said that whilst they were all competitors in the marketplace, there had been a growing feeling that they should be co-operating in areas of mutual interest. Now that this Group has been formed, the co-operation stands to benefit not only members of the Group itself,

but also the HVAC industry as a whole and, of course, all their customers.

The mission of NAVCOG is to raise the profile and professionalism of NAVCOG members; to improve product certification, design methodology and industry specifications; and to review performance guarantees and services offered within the HVAC industry.

Of the issues that will be addressed in the coming months it has been agreed to give priority to: raising awareness with acoustic consultants; product certification; common technical data eg system losses; guarantees and warranties; application guidelines; and industry specifications. Other issues of concern that were brought into the spotlight include: skills shortages; trading practices and insurances and representation on relevant standards committees including the BSI Technical Committee for ISO 7235: 2003.

Michael Duggan is Technical Manager of FETA and HEVAC. He says that the formation of NAVCOG reflected the need in the sector for the establishment of a level playing field. By improving certification and industry specification parameters, designers and manufacturers would be better able to compete fairly, while specifiers and consultants would be empowered in making better-informed choices. The end result would be higher standards across an industry that for many years had lacked the standing it deserves. He looked forward to seeing the fruit of their labours.

For more information on NAVCOG or FETA visit www.feta.co.uk or contact Geoff Crowhurst on: 01962 873000 / geoffc@iacl.co.uk

EWS

Health & Safety Minister calls for protection of call centre workers

Opening the UK's first Acoustic Safety Conference at the National Physical Laboratory in Teddington, Lord Hunt of Kings Heath stressed the importance of controlling noise at work and protecting the hearing of Britain's one million call centre workers.

Acoustic shock is the result of a random frequency surge delivered via a headset, caused by a sudden spike in noise that can damage the human ear. There are at least 170,000 people in Britain today suffering from deafness or tinnitus caused by work-related conditions with hundreds of legal cases pending.

"Taking action early can prevent these problems," said the minister, "the most important advice for call centres is to have a traceable reporting system for headset users, and that headsets should have built-in protection against high noise levels."

Speaking after Lord Hunt, Dave Joyce of the CWU welcomed the government's support for the Acoustic Safety Programme, and called for greater vigilance by call centre owners and environmental health officers to protect the hearing of Britain's call centre workers.

The conference was organised by the Call Centre Management Association and sponsored by Clement Clarke Communications (headset manufacturers) and Tecton plc (who make the software which detects and removes sudden noise from headsets), plus the Communication Workers Union and ProCerus occupational health.

Because of the high level of interest a second conference was arranged on 11 November at the National Physical Laboratory.

Further information about the conference can be found on www.acousticshock.org

What A Horrible Noise!

The Badvibes Project

The BadVibes project, an investigation hoping to find the world's worst sound, has been launched by Prof Trevor Cox of Salford University. The researchers are aiming to discover something about our ancestors' reactions to various sounds, and eventually help to make the world less stressful for homo sapiens sapiens. BadVibes was launched at the Manchester Museum of Science and Industry, with the intention of making the general public think about how sounds are listened to and interpreted.

Various unpleasant and unattractive sounds are presented on the project web site (www.sound101.org) where surfers can listen then vote on their preferences - or rather, the reverse - including coughs and snores. More than 600,000 had participated at the time of writing. So far, the worst sound seems to be that of vomiting!

It is not always easy to predict whether or not someone will be annoyed based on the physics of a sound wave alone. Noise affects quality of life, and if the worst sound in the world, and the reasons why it is the worst, can be found then stress and antagonism can possibly be reduced.

It seems that when a listener has some degree of control over a noise, it tends to be less annoying. Conversely, fear of the noise sources makes matters worse. A neighbour's hi-fi is not nearly as annoying for someone about to go to the party.

A pioneering study was conducted in the 1980s, and found the worst sound was a garden tool scraped across slate. This was similar to fingernails being scraped down a blackboard: the unpleasantness apparently resulted from the mid-frequency content, which was surprising. It might be expected that high frequencies to be the most unpleasant, since what is most noticeable when fingernails scrape down a blackboard is the shrill, high-frequency nature of the sound.

There is speculation that we react to squeaking because it is redolent of the warning cry of a primate ancestor, but some species of tamarin react in the same way to a screeching sound as to white noise at a similar level. If the dislike of scraping sounds came from some ancient reflex, it was not present in the tamarins.

The project is backed by the Engineering and Physical Sciences Research Council and run by Prof Cox at the Acoustics Research Centre, University of Salford.

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We are looking for enthusiastic candidates with experience in all aspects of acoustic design, particularly architectural and environmental work. You should have a working knowledge of current standards and procedures and have good spoken and written communication skills.

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Mr. P. R. Dunbavin
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All applications will be treated in the strictest confidence

TQV

New service helps engineering employers make the right choice



Recent research by the Engineering Council UK (ECUK), carried out by means of a postal questionnaire sent to 2500 engineering employers in the UK, revealed that

30% of employers find it difficult to verify the CVs of applicants for engineering and technical posts. Fortunately for such companies, help is at hand in the shape of a new service from Technical Qualifications Validation (TQV) Ltd, a newly formed joint venture created by ECUK and the engineering institutions that are its licensed members.

Many employers of engineers lack the time and/or personnel to properly check candidates' qualifications and experience. Yet serious consequences can result from appointing people who have exaggerated their abilities, including loss of business and long-term damage to a company's reputation. TQV is able to offer a solution to this dilemma because of its access to the wealth of data and expertise within ECUK and the latter's 36 member institutions.

It is a simple matter for TQV to check

whether a qualification cited by an applicant actually exists and whether it appears on the ECUK's list of accredited engineering degrees and other courses. In the case of a person educated overseas it would establish equivalence with a qualification gained in the UK. Crucially, it is then able to check that the individual holds the qualification claimed - regardless of whether it was awarded in the UK or overseas. If required, it can also arrange for a candidate to undergo a probing interview by an appropriate panel of experts. This is identical to the Professional Review Interview faced by all those who apply to become Registered Engineers.

On request - and free of charge - TQV will verify whether a named individual appears on the ECUK's database of 250,000 registered engineers and technicians. Registration in itself provides proof of a person's knowledge, competence and commitment to professional standards and thus makes the other checks unnecessary.

Andrew Ramsay, Chief Executive of the Engineering Council UK, anticipates strong demand for the new package of services. He says that many engineering employers stood to benefit from using TQV. When recruiting

people to senior positions even major companies with large HR departments were likely to find it valuable. Potential clients included the increasing number of UK companies setting up overseas operations. They faced particular difficulties when trying to recruit locally, difficulties that this innovative service could help to solve.

The fees charged by TQV are said to be relatively insignificant compared with the generally high cost of recruitment. Recruiting a person who is not up to the job could turn out to be a great deal more expensive.

Technical Qualifications Validation Ltd has access to a database of over 4000 accredited UK engineering degrees, higher nationals and other qualifications. In the case of overseas engineering courses it can readily establish the UK equivalents of some 20,000 qualifications.

For more information:
Ed Hallatt (Communications Manager)
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Email: ehallatt@engc.org.uk

Expert Evidence Could Be Rejected

The Court of Appeal lets HAVS sufferer keep £21,000 damages

The Court of Appeal recently dismissed an appeal against a decision to award the Claimant £21,000 damages as a result of the negligence of the defendant, Montracon Ltd. The judge had awarded the damages for negligence in that his employer, the manufacturer of heavy good trailers, had caused Mr Gregory Whalley to contract hand-arm vibration syndrome (HAVS). The judge in the County Court had found that Mr Whalley was a reliable witness, and the Appeal Court upheld the view that he was entitled to reject expert medical evidence which disputed the claim.

Mr Whalley alleged that he had contracted HAVS as a result of the prolonged use of vibrating tools, and several other employees had entered similar claims. Once the judge had found as a matter of fact that Montracon should since 1991 have been aware of the adverse effects of the prolonged use of vibratory tools, the employer should have taken steps to warn its employees of the risks, provided periodic medical examinations and put measures into effect to reduce the extent of the vibration exposure. The defendant failed to do so, and any claimant who could

show prolonged usage of the relevant tools since 1991, and had symptoms of HAVS, would succeed. In Mr Whalley's case, because there was no doubt that he had used the tools for a long period of time, the issue was whether or not he was suffering from HAVS.

The claimant had been examined by doctors for both sides once the proceedings had commenced. The doctor instructed on his behalf had concluded that the symptoms of HAVS were present, but the defendant's doctor disagreed. At the hearing, the judge heard evidence that Mr Whalley had a blotchy appearance to his fingers at the onset of an attack, so the defendant's doctor changed his evidence. The doctor said that although a leading HAVS expert accepted blotchiness as consistent with HAVS, he personally had never done so. Nevertheless, the judge accepted Mr Whalley's evidence as truthful and accurate, and concluded that everything save the evidence about the blotchiness pointed to a diagnosis of the vascular component of HAVS. Damages were therefore awarded, and Montracon appealed.

The appeal judges found that the trial judge

had been entitled to reject the defendant's doctor's evidence, as all issues of credibility were for the judge to decide. If a witness gave ambiguous or doubtful evidence, it was solely for the judge to determine the correct interpretation. Mr Whalley had given a 'textbook' account of the vascular component of HAVS, save for the blotching, and there was no constitutional condition to account for the symptoms. Moreover, the engineering evidence was that there was a risk of HAVS because of the exposure to vibration. There was but one piece of the evidential jigsaw, said Lady Justice Smith, which did not appear to fit. Even if there had been no explanation for the ill-fitting piece, the judge had been entitled to say that that on the balance of probabilities, he was satisfied that the claimant was suffering from HAVS. Where the civil standard of proof was applicable, it was not necessary that every piece of the evidential jigsaw had to fit. If that were required, there would be a higher standard of proof, and in any event, there were other possible explanations for the ill-fitting evidence.

Noise Nuisance & Sound Insulation

Dani Fiumicelli MIOA. Inadequate sound insulation between buildings

Since the House of Lords decisions in *Southwark London Borough Council v Mills & Orrs: Baxter v Camden London Borough Council* [1999]: [Times, 22 October 1999], it has not been possible to use the nuisance limb of statutory nuisance to deal with inadequate sound insulation between dwellings.

However, this still left the 'prejudicial to health' limb open, and recently the High Court examined this point in the case of *Mark Vella v Lambeth London Borough Council and London & Quadrant Housing Trust* [Times, 23 November 2005].

Mr Vella lived in a flat in a converted house and he complained to the London Borough of Lambeth about excessive transmission of noise from the upstairs flat and from the communal areas. Following their investigation, Lambeth decided that the premises could not be classified as a statutory nuisance, so there was no justification for an abatement notice being served on Mr Vella's landlord.

Mr Vella then sought a judicial review of the London Borough of Lambeth's decision. He conceded that action against his neighbours, or the use of the 'nuisance' limb, was not possible because of the House of Lords decisions, but he contended that the Council could fall back on the 'prejudicial to health' limb of statutory nuisance to take action against his landlord.

Lambeth Council's own investigations, and evidence from Mr Vella's side, demonstrated that the sound insulation to the flat was below the current and preceding sound insulation standards of the Building Regulations. Mr Vella also presented evidence that excessive noise from ordinary use of the neighbouring flats and the common parts of the building regularly intruded into his home, and a psychologist gave evidence that his mental health was adversely affected by the intruding noise.

In reaching their conclusions the judges referenced the Appeal Court decisions in *R v Bristol City Council ex parte Everett* [1999] LGR 513, and *Birmingham City Council v Oakley* [2001] LGR 110. These cases explored the legislative history of the concept of statutory nuisance, going back to its mid-Victorian roots, and concluded that the term 'prejudicial to health' should be interpreted in line with its origins in sanitation; and that section 79(1)(a) of the Environmental Protection Act 1990 was directed to the presence of some feature of premises which was in itself prejudicial to health, by way of being the source of possible infection, illness or disease.

The Judges stated they had also taken into account the following:

- The disturbance complained of was due to the presence of noise, which is not a 'state' of the premises, because it relies on

an activity causing it;

- The disturbance complained of was not the kind envisaged by Parliament when it drafted section 79(1)(a) of the Environmental Protection Act 1990, because the phrase 'in such a state as to be prejudicial to health' denoted a steady or continual state of affairs, in contrast to the occurrence of noise which was often intermittent;
- The mere absence of adequate sound insulation was not prejudicial to health, as on its own it was not injurious to health: there had to be noise making activity in order to give rise to any intrusive noise;
- Parliament had chosen to treat disturbance due to noise differently from the state of premises by constituting separate powers to deal with noise prejudicial to health or noise nuisance under sections 79(1)(g) and 79(1)(g)(a) of the Environmental Protection Act 1990.

Additionally the judges gave weight to the fact that Parliament had provided alternative powers for local authorities to deal with sound insulation, including the Building Regulations and the Housing Health and Safety Rating System. Reference was also made to the 'Decent Homes' initiative whereby all social housing should be brought up to a reasonable standard by 2010.

The judges also commented that immense financial burdens would be imposed on social and private landlords if the Court were to require, by the statutory nuisance route, the immediate upgrading of properties to a standard of sound insulation that had not been required when the properties were constructed or adapted.

Consequently, the judges decided that the London Borough of Lambeth had not been wrong to conclude that lack of adequate sound insulation could not cause premises to be in such a state as to be prejudicial to health for the purposes of section 79(1)(a) of The Environmental Protection Act 1990. Consequently, the local authority's decision not to serve an abatement notice on the landlord was lawful and legally correct.

This decision closes the door on the use of statutory nuisance powers to deal with inadequate sound insulation in most circumstances.

However, the cases of *Stannard v Charles Pitcher*: (2003) Env LR 10 and *Sampson v Hodson-Pressinger* [1981] 3 All ER 710, mean it may still be possible to use statutory nuisance powers where sound insulation to dwellings becomes inadequate owing to changes in the premises, rather than deficiencies in the original construction.



Present-day sound insulation standards are superior to those within older buildings

New Concert Centre For The North East

**The Sage Gateshead -
specialist acoustic partitions & ceilings
from British Gypsum**

Specialist acoustic partitions and ceilings from British Gypsum were used to meet demanding performance criteria for one of the most acoustically challenging buildings to be constructed in the UK in recent years.

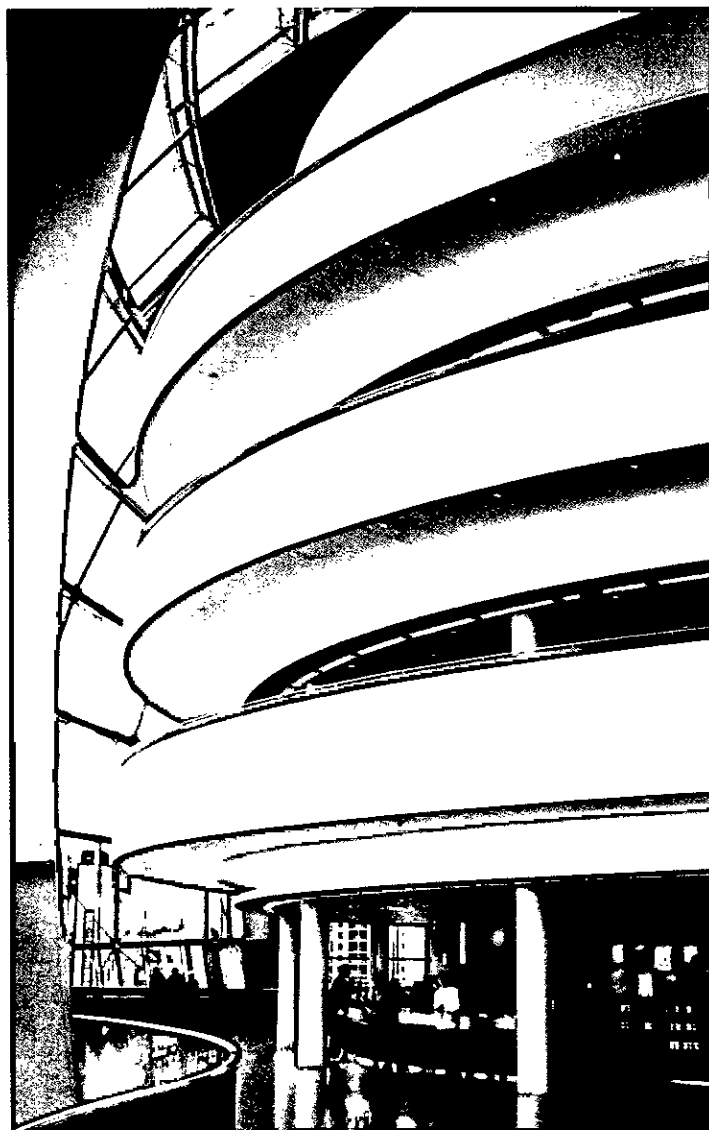
Overlooking the Tyne, Foster and Partners' landmark The Sage Gateshead is the centrepiece of the city's riverside regeneration project, bringing together performance spaces, rehearsal rooms and a 25-room music education centre in a single dramatic and architecturally innovative structure.

To help achieve the outstanding acoustics required of the £70 million centre, experts from British Gypsum worked alongside consultants from Arup Acoustics to develop a complete lining and partitioning specification for the compartmentalised concrete box structure of The Sage's Hall One.

Throughout the centre, vast quantities of British Gypsum Gypliner board, GypWall Staggered and GypWall Classic metal framing systems were used for partitioning and wall lining. Internal walls to all classroom areas were lined with GypWall IVL, an independently-framed lining system, faced with three layers of SoundBloc board. Lower-level metal framed ceilings were formed from CasoLine MF lined with three layers of Gyproc wallboard and underdrawn with an Artec Gyptone feature set in 1200mm rows. In Hall Two, an Artec Gyptone Point 11 suspended ceiling combined good acoustical absorption with an eye-catching visual design.

All the British Gypsum products used on the project were installed by Johnson Brothers, Leeds, and partitioning contractors GT Contracts.

The complex opened in Autumn 2005 to great critical acclaim. Further details can be found at www.british-gypsum.com



Meeting Notice

IOA Meeting, London, 17 May 2006

HARMful? - Judge for yourself! Making the vibration regulations work safely

The Institute of Acoustics is holding a one-day meeting on Wednesday 17 May, at the Society of Chemical Industry, London, covering the implementations of the Health and Safety Regulations. The in-service vibration data available for whole-body emissions are considerably less than those for hand-arm. This leaves the manager or safety officer in a difficult position.

This meeting will comprise presentations to bring clarity to the assessment of risk from the estimations of the work process, the data from test codes and in-use vibration values coupled with uncertainty at each step. Guidance documents, which suggest correction factors from measurement data, will be part of the framework for the day.

Beyond the risk assessment, where questions could to be asked in a Civil Court about evidence of applied correction factors, plus the application of any uncertainties, this will be considered.

Who should attend? Managers, safety advisors, trades unions insurance companies, manufacturers as well as consultants.

For more contact the Institute office or
Martin Armstrong, Alcor S&V (Meeting Organiser)
tel: 01223 262770
email: martin.armstrong@bksv.com

Conference Report

Quiet homes for London

The University of Derby was commissioned to undertake a scoping study on behalf of the Greater London Authority to investigate the feasibility of developing a Quiet Homes for London initiative. The objectives of the scoping study were:

- To review the range of potential targeted noise-relief measures that might realistically be considered, and advise on feasibility and implications
- To analyse measures previously adopted in particular housing sectors (local authority, other social landlord, private rented, owner occupied) - eg tenant allocation policies, over-50s housing
- To review experience from the use of targeted noise-relief measures, and advise on issues any new initiatives would need to address
- To draw general lessons from the above and advise on noise and housing policy implications
- This should include any wider social and equalities issues raised by the schemes studied
- To suggest any potential implementation mechanisms (legal, financial, other), existing or capable of development, which could help to promote schemes drawing on any successful experience identified by the study
- To note any areas where further research or other work would be needed
- To identify specifically any equality issues and implications.

To inform the above objectives the following issues including options for initial consideration were reviewed:

- A brief resume of the relevant effects of environmental noise
- Housing allocation policies
- Protecting housing from noisy entertainment
- Improving how noise nuisance is tackled in the social rented sector through tenancy agreements and management practice
- Providing temporary alternative housing with the aim of alleviating the effects of long term intrusive noise
- The Regulatory Reform Order 2002 and the use of grant aid to improve noise insulation
- Home insulation grants

- The Decent Homes Standard
- The Housing Health and Safety Rating System
- Quiet homes and category labelling
- A London quiet homes register
- Design and management guidelines influencing noise levels.

The conclusions drawn were:

1. A London-wide sample study be undertaken to estimate the extent of the sound insulation problem and associated remedial costs
2. A pilot study would be useful to examine the feasibility of introducing noise sensitive criteria as a part of the housing allocation process
3. Review of the impact of the Licensing Act 2003 should include evaluating its effectiveness in minimising the noise impact of the late night economy on noise-sensitive dwellings
4. The second phase of the Good Practice in the Management of the Evening Economy case studies (Civic Trust) will need to be evaluated for evidence to support strategies to ensure that the interests of residents are protected with regard to noise; and the noise impact of the late night economy needs to be fully recognised in any revision of PPG 6
5. Sound insulation measures need to be incorporated into the London Boroughs' definitions of 'eligible work' for the purposes of private sector renewal activity, be it grant aided or otherwise
6. A pilot scheme is undertaken to examine these common areas and to evaluate the effectiveness that such a joint approach might have
7. Government departments should give sound insulation greater priority in any new or revised Decent Homes standard
8. A 5-year review of the HHSRS should include how the London Boroughs have implemented and used the new HHSRS specifically to deal with poor sound insulation in dwellings
9. An evaluation of different labelling schemes relevant to quiet homes should be undertaken to indicate the most appropriate for sound insulation

10. A conference should be organised to raise awareness of Quiet Homes issues in London, to prompt discussion of the issues, such as outlined in this scoping study and to provide a national or international forum for the dissemination of good practice.

Sound Reduction Systems Ltd (SRS) are proud to announce their involvement in the subsequent Quiet Homes for London conference at City Hall organised by the Mayor of London, Ken Livingstone, in conjunction with the UK Noise Association. The event was designed to raise awareness of the issues surrounding poor sound insulation in high density accommodation in large cities such as London. Participation was sought from leading individuals and organisations involved in acoustics, sound insulation and housing such as Dr Sean Smith MIOA, Principal Research Fellow, Napier University; Nick Antonio MIOA, Arup Acoustics; Chris Scott, Senior Architect at BRE and Sound Reduction Systems Ltd, manufacturers of acoustic insulation products.

Presentations on the day dealt with many issues including a review of the options available to increase sound insulation, one of these being a provision for internal sound insulation in the Decent Homes Standard, a consumer rating for quiet homes, acoustic regulation, design and practice and practical acoustic insulation within the home by Sound Reduction Systems.

Organised largely through the hard work of Max Dixon, Principal Strategy Officer (Noise), Greater London Authority and Val Weedon MBE of the UK Noise Association, the conference was attended by a wide range of individuals with an interest in the subject. The audience consisted of Building Control Officers, landlords, tenant's representatives, architects and independent individuals who attended because of their personal interest in improved sound insulation between adjoining dwellings.

The event proved to be a great success, and of worth to all members of the audience.

The report in full can be found at www.london.gov.uk/mayor/strategies/noise/docs/Quiethomesforlondon.pdf

For further information on Sound Reduction Systems solutions to acoustic insulation within the home, phone **01204 380074**, email info@soundreduction.co.uk or visit the website www.soundreduction.co.uk

notified body : laboratory : site : building acoustics : dedicated pre-completion testing team



Fire Acoustics Structures

0115 945 1564
www.btconline.co.uk
bbc_testing@bpb.com



Ralph Weston

Retires from the Hearing Protection Committee

CEN TC 159, the European Standards committee for the EN352 series 'Hearing Protectors - product standards' held a plenary meeting at BSI London in November 2005. Ralph Weston, who has just retired from the committee, has served as an Institute-nominated member of the national committee (BSI PH/7) for several years and was the leader for the development of EN458 'Hearing protectors: recommendations for selection, use, care and maintenance', cited by many of the member states in relation to the implementation of the Physical Agents (Noise) Directive.

Ralph is pictured here (standing, 3rd from left) with several colleagues at an informal reunion. The other UK members are Mohammed Saleem MIOA of 3M plc (standing, 4th from left); Mike Denton of Aearo, an IOA Sponsor Member (standing, 6th from left); and Peter Wheeler FIOA, chair of BSI PH/7 and convener, TC159/WG2 (standing, 3rd from right). Barry Jaynes, secretary of the UK hearing protector manufacturers group, is standing at the extreme left of the picture.



Dr Gerald C McCullagh

Obituary by Oliver Hetherington MIOA

Many members will be sad to hear of the death of Dr Gerald C McCullagh in October 2005. Gerry was well known to many, not only in the field of acoustics but in education and sport. After graduating in physics at Queens University Belfast, he went on to complete his doctorate and began a career in education at the College of Technology, Belfast. On the foundation of the Ulster Polytechnic in 1971 he became a founding member of staff in the Department of Building and there developed an interest in acoustics and noise control. He was responsible for the development of teaching and research in this area within the department at both undergraduate and postgraduate level and along with Dr Brian Smith, introduced the course for the Institute Diploma in Acoustics and Noise Control in 1983. Gerry was very keen to share his knowledge and expertise and to that end organised numerous short courses in environmental, architectural and occupational noise. Many practitioners in these fields have benefited not only from the courses but from their association with Gerry. In recognition of his contribution to acoustics research, he was appointed Reader in the School of the Built Environment at the University of Ulster in 1990.

Many 'old hands' from the Windermere Autumn Conference days will remember Gerry with great affection, not only for his wit and wisdom, but also for the opportunity to sample some of his 'fire water' specially smuggled across the water from his native County Antrim for the benefit and delight of his English friends. This writer was welcomed more than once to the conference with the words, 'Where's Gerry?'

Following his retirement from full time education in 1995, Gerry pursued his ambition of establishing a Branch of the Institute of Acoustics in Ireland. Under his guidance, a Branch Committee was formed in 1998 and chaired by him until 2004, when his failing health prevented him from taking an active part. During that time, he travelled extensively not only in Ireland to publicise the activities of the Institute but also as a member of the Institute Council.

Gerry's other passion was rugby and he maintained a lifelong interest in the game, both as a player and official. He was a member of Larne RUFC and for a number of years, a member of the Ulster Branch of the IRFU. He was well known in the sport, not only in Ireland but as far away as Australia, where he led a team to a 'golden oldies' tournament when he was almost entering his fifth decade.

The church of St Cedma's in Larne was filled to overflowing to give thanks for the life of Gerry and to sympathise with his family. Our thoughts go out to his wife Rita, his son Peter and daughter Caroline.

Cirrus CR:261 & 262

Facing the challenges of the new Control of Noise at Work Regulations

The introduction of the Control of Noise at Work Regulations 2005, which will now come into force on 6 April 2006, will impose new limits on employers concerning the level of noise exposure of employees, and require steps to be taken at different action levels. One of the most significant additions in the new Regulations is the introduction of the Exposure Limit Values at an LEP,d of 87dB and a peak sound pressure level of 140dB(C). These new limits will require many more employers to take account of noise levels in the workplace and to produce risk assessments and noise measurements to achieve compliance with the Regulations.

The Regulations are published as a document available from the HSE (L108 Controlling Noise at Work, The Control of Noise at Work Regulations 2005, Guidance on Regulations) and this document clearly defines these new limits and the responsibilities of employers to reduce the risk of hearing damage and to control exposure to high noise levels.

Although the music and entertainment sectors have until 6 April 2008 to comply with the Regulations, those sectors are still required to meet the noise limits set out in the Noise at Work Regulations 1989, a challenge that must be met.

Cirrus Research plc has produced a range of noise measurement equipment which can be used for the assessment and control of noise in the workplace and many of these instruments have innovative functions designed to help the employer make noise measurements quickly and easily.

The doseBadge Personal Noise Dosimeter has been updated in line with the requirements of the new Regulations, and the new CR:110A version of the doseBadge provides for the measurement of LAeq, LCPeak and LEP,d whilst maintaining the unique features of the doseBadge system.

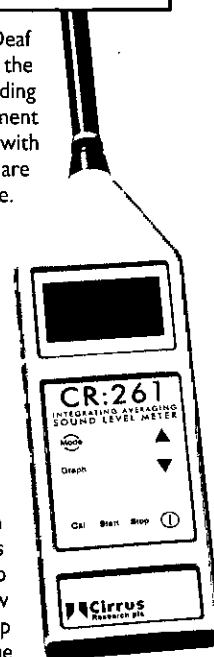
The CR:262 and CR:261 sound level meters were designed to be as simple to use as possible with only three button pushes required to make a measurement.

The data logging CR:800B Series, which feature the Deaf Defier3 software, can provide additional information to the user and allow quick reports to be produced recording information about the noise measurements and the equipment used. The Deaf Defier3 software has been updated in line with the new Regulations and updates for this software package are available free of charge from the Cirrus Research plc website. Registered users will be notified of new versions and updates when they are available.

Although making a noise measurement in itself is not enough to comply with the regulations, where noise measurements are made it is essential to get accurate information and to be able to provide good quality records, including relevant comments and notes of the assumptions made. Cirrus Research plc aims to provide these features in all of its instruments, in particular those targeted at Health and Safety Officers and noise measurement professionals.

As well as producing the instruments, Cirrus has been running a series of Noise Measurement Workshops designed to provide those attending with an introduction to the new Regulations as well as practical examples of how noise control and noise measurements can be used to help reduce the risk of exposure. These workshops will continue through 2006 and the number of venues will be increased to cover the demand for information and advice about the new Regulations.

For more information: James Tingay, Cirrus Research plc
Tel: 01723 891655, Email: james.tingay@cirrusresearch.co.uk



Letter

John Houldsworth MIOA,
Building Regulations 2000: Approved Document E

Pre-completion testing

Certain concerned members have expressed their disquiet about the ANC presumption of authority on these matters. Informal discussions have taken place with senior figures in the Institute, but unfortunately, there is little solace likely in the near future in terms of an IOA Certificate of Competence. Nevertheless, it is well known that several well-established and professional acoustical consultancies (albeit relatively small-scale operations) have been carrying out sound insulation testing to satisfy the requirements of the Building Regulations 2000. At that point, there was not too much concern, as the Office of the Deputy Prime Minister's guidance on the subject clearly states that UKAS accreditation or ANC scheme registration is 'preferable' – but this does not mean 'mandatory'. If it were mandatory, the ODPM would have said so. However, things have recently deteriorated sharply.

A number of local authority Building Control Departments have now begun to refuse reports by MIOAs on the grounds that the members in question were not UKAS accredited or ANC registered. This was in spite of the fact that in two known cases, the acoustical consultant in question is regularly employed and recommended by the same authority's very own Environmental Health Departments! Manchester City Council, to name one, has stated that Local Authorities were being guided from ODPM that this was the way to go. Certain regional offices of the National House Builders' Council (NHBC) have come to the same conclusion, apparently as a result of guidance from Head Office. Clearly, this is rather worrying for all non-ANC and non-UKAS accredited IOA members and organisations.

However, another local authority's Building Control Officer has suggested that the UKAS/ANC paperwork is rather academic, since there is a note elsewhere in Approved Document E saying that IOA membership was the best recommendation for quality of service from an acoustical consultant.

Norsonic 132

New noise at work regulations

The E.U. Physical Agents (Noise) Directive 2003

The new noise at work legislation is due to come into force in early 2006 which will bring large changes to many workplaces throughout the UK.

The current regulations are to be superseded with the limiting or action levels being reduced by 5dB from 85dB to 80dB (LAEP,d). It is estimated that an additional 2 million workers fall into this 80 to 85dB exposure range and this will require immediate attention and action by employers.

The first step for an employer is to quantify the problem and carry out a risk assessment for noise. This involves using instrumentation which complies to IEC 389217317 type 2 standard to measure sound. Norsonic provide a complete package in the new Nor132 Sound Level Meter which is designed to be simple to use and robust in design. The instrument measures and stores all the required parameters simultaneously which can then be connected via a USB connection to a PC. The user then simply drags and drops the measurements to instantly produce test certificates which will advise if the new or existing limits are exceeded.

If a noise problem is identified then the source of noise should be tackled to bring workers within acceptable limits. In addition, further protection can be provided with the supplied Nor-Protector software to help the user select the most appropriate type of hearing protection. To prescribe hearing protection information on the frequency content of the noise is required and the Nor132 sound level meter is able, in real time, to collect this frequency analysis information which is also transferred to the software. Within the software the user can add new devices to the on

The other references were just saying that these were other possibilities. Further research has revealed the following.

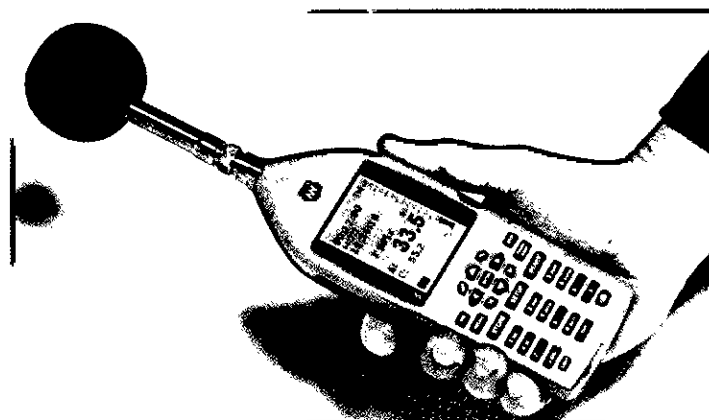
Section 8 of Approved Document E is about 'Acoustics in Schools'. The relevant document is, of course, called Building Bulletin 93. There follows an extract from the first page of Section 1: Specification of Acoustic Performance in BB93.

'The normal way of satisfying Requirement E4 of The Building Regulations is to demonstrate that all the performance standards in Section 1.1, as appropriate, have been met. Section 1.2 sets out the preferred means for demonstrating compliance of the design to the Building Control Body (BCB). Section 1.3 describes acoustic tests that can be used to demonstrate compliance with the performance standards in Section 1.1. It is strongly recommended that the client require acoustic testing to be carried out as part of the building contract, because testing of the completed construction is the best practical means of ensuring that it achieves the design intent.'

In all but the simplest of projects it is advisable to appoint a suitably qualified acoustic consultant⁽¹⁾ at an early stage of the project, before the outline design has been decided. This will prevent simple mistakes which can be costly to design out at a later stage. An acoustic consultant will normally be needed to check the design details, and on site construction, and to carry out acoustic tests to confirm that the building achieves the required acoustic performance.'

The Institute should be particularly happy about the word 'primary' in the above note. Nevertheless, the ODPM (not to mention the NHBC) is apparently saying that developers are recommended to use an IOA member to do design and testing in Section 8, but those same IOA members are excluded from testing in other places. This would seem to make no sense at all. The correct interpretation is, surely, that IOA members and organisations have always been approved of and recommended for testing, but admittedly it was rather well hidden. Of course, if those carrying out the testing are CEng or IEng registered, with the concomitant Continuing Professional Development, so much the better. The note (1) should really be added to the appropriate part of Section O: Performance of the Approved Document (Paragraph 0.4) in the same way that the ANC note was added.

In the meantime, however, members probably should not get too upset about the ANC and its scheme. It does provide an opportunity for some less experienced small organisations to gain some knowledge of practical acoustics at the sharp end. After all, you do not **have** to be an IOA member to be in the ANC.



board database of hearing protection and instantly recalculate exposure levels with different types and models of hearing protectors.

The Norsonic 132 Sound Level Meter has been specifically designed for the Health and Safety market and the new regulations. Equipment is available for hire or sale.

For further details and available from Justin Barker,
 Campbell Associates Ltd, Sonitus House, 5B Chelmsford Rd Industrial
 Estate, Great Dunmow, Essex, CM6 1HD.
 Tel 01371 871033 Fax 01371 879106
 justin@campbell-associates.co.uk
 www.campbell-associates.co.uk www.acoustic-hire.com

Campbell Associates are the exclusive distributor for Norsonic Instrumentation in the UK and Eire. Established in 1998 Campbell Associates offer sound and vibration instruments for sale and hire and run a traceable calibration laboratory.

(1) The primary professional body for acoustics in the UK is the Institute of Acoustics (www.ioa.org.uk). An experienced professional acoustician who is competent to be responsible for the acoustic design of school buildings would normally be a corporate member of the Institute of Acoustics.

Coyle Personnel's specialist acoustics division have in excess of 10 years technical recruitment experience in the field of Acoustics and Noise. We work with some of the UK's most prominent and respected Consultancies and Manufacturers.



Acoustics Division

Creating positive

partnerships

Senior/Principal Acoustic Consultant Bristol Area

£30k-£35k+

My client is a leading multidisciplinary engineering consultancy with offices throughout the world, who require a technical expert to take a senior role within their Building Acoustics group. This is an opportunity to join a fast growing team taking responsibility for a leading a number of key projects throughout the West of the UK. Most projects involve design and consultancy advice to contractors on multiple use developments, so experience in this sort of development would be an advantage. You will have at least 4 years post graduate experience with at least 2 years of that in consultancy. Ideally you will be a full member of the IoA and have a bias towards building/architectural acoustics. In return, we can offer a highly competitive salary package with opportunities for career development and an exciting array of projects.
Ref: ac1201

Principal/Associate South West

£excellent

This firm has an exciting opening for a highly skilled acoustician to lead and develop their West Country architectural/buildings acoustics business. You will have extensive exposure to the market with knowledge of working with architects and contractors and over 10 years building acoustics experience gained in a consultancy environment. This is an opportunity to develop and build a new team within an established acoustics group, the company currently have successful teams of acousticians in several of their offices and they are looking to build on this success in the South West.
Ref: ac1202

Senior Acoustic Consultant S Yorks/East Midlands

£30k+

We require an experienced consultant with 4 years+ experience in acoustics to take a position within an established but growing acoustics team. The role offers a diverse range of acoustics projects from residential developments to commercial & public sector as well as environmental acoustic projects such as EIAs and Noise & Vibration surveys. You should be confident in a client facing situation and able to manage your own project workload.
Ref: ac1203

Principal Consultant London or Berkshire

£35k-£40k

My client are a leading engineering & development consultancy with offices throughout the UK. They require a highly experienced consultant to take a senior role within their noise & vibration group. This is a good opportunity for a senior consultant to take the next step and take a team leading role setting up and developing a new acoustics group within an established company-wide acoustics group.
Ref: ac1204

Consultants UK wide

£20k-£30k

We also require acoustics consultants with over 1 years experience in environmental, architectural or industrial acoustics for consultant posts at all levels across the country.
Ref: ac1205



Contact

Mark Armstrong
Coyle Personnel plc
30-31 Friar Street
Reading
RG1 1DX

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Fax: 0118 955 0668

Direct: 0118 955 0604

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www.coylepersonnelplc.co.uk

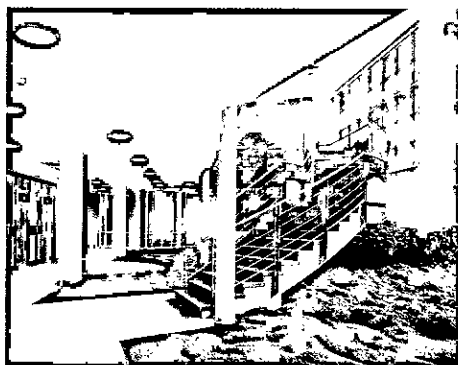
British Gypsum

News

Casoprano offers massive benefits for ceilings

Today's suspended ceilings are expected to do more than just provide a lining to hide services and structural features, they need to contribute to the overall environment of the room, helping to improve acoustics in the space and providing a pleasing aesthetic appearance.

The secret to improved sound insulation performance is mass, which is where gypsum-based Artec Casoprano ceiling tiles win hands-down, according to their manufacturer, British Gypsum.



The extra mass provided by Casoprano tiles means that they have a natural sound insulation far higher than the traditional mineral fibre tiles, which often require the installation of expensive additional panels in areas where acoustic performance is important. The extra mass also helps to prevent tile lift or displacement associated

with door opening or draughts in smaller rooms, thus negating the need for special fixing clips. This means that the ceilings not only perform more effectively, they stay looking good for longer.

Extra mass is just one of the benefits that make these tiles the natural alternative to mineral fibre for most modern suspended ceiling applications. This message is being reinforced through a series of hard-hitting boxing-themed mailings and promotions, currently being targeted at ceiling specifiers and installers.

Further information is available on the company's website

www.britishgypsum.com/arteco where enquirers can also enter a draw to win a pair of boxing gloves, signed by English boxing legend, Sir Henry Cooper.

New edition of the White Book

Quicker and easier to use, and with more design information than ever before, the latest edition of the British Gypsum White Book is now on-line at www.british-gypsum.com/whitebook. The White Book extends to more than 500 pages and has taken British Gypsum's team of draughtsmen, technical experts and designers eighteen months to compile. The book has been extensively restructured following research with regular users.

Design guidance has now been expanded and brought together into an easy-to-reference 50 page section, which leads the user through every aspect of system design, from legislation and standards, to good-practice design, system interaction with the main structure and key drivers like sustainability and health and safety. As a result individual system information has been produced in more compact form, with a clear focus on key



performance data and detailing.

In anticipation of the new European fire performance standards, all system performance data is for the first time quoted to both BS and EN standards, giving specifiers total flexibility when working to either standard.

To meet users' requests for more information on system components, the products section has been considerably expanded with more comprehensive data on key products, such as plasterboards. There is a new glossary, an expanded index and a new literature section detailing the range of sector brochures, product and technical guides and other literature available to support the White Book.

Users of the on-line version of the White Book will have the advantage of guaranteed up-to-date information, as sections will be updated on a day-to-day basis as system information and guidance changes.

Regular users of the White Book are also being given the opportunity to shape the future development of the White Book, by feeding back their comments and suggestions to a special e-mail address:

whitebook@bpb.com.

For more information: Paul Smith
Corporate Communications Manager

Tel: 0115 945 1938

Fax: 0115 945 1111

Email: paul.smith@bpb.com

Brüel & Kjær

New long-term environmental noise monitoring software is ideal for workplace noise assessments

New Enhanced Logging software for the long-term monitoring of broadband and spectrum data is now available to support Brüel & Kjær's innovative Type 2250 fourth generation hand-held analyser. The new BZ7225 software is ideal for implementing noise profiling investigations as well as providing continuous monitoring and logging of periodic reports for the development of time histories used in environmental noise and workplace noise assessment studies.

The software allows free selection of parameters to log at periods from 1 second to 24 hours. All broadband parameters can be logged by running the Enhanced Logging software in conjunction with Brüel & Kjær's Sound Level Meter software (BZ7222).

The spectra can also be logged at the same rates by enabling Brüel & Kjær's Frequency Analysis software. To address the requirements of US and EU regulations the new Enhanced Logging software module calculates the Ldn, Lden, Lday, Levening and Lnight parameters.

In the event of a power failure during the continuous monitoring process the Enhanced Logging software automatically reboots and resumes operation. Data is saved in manageable portions (every 24 hours) selectable for download. The user-friendly software also allows operators to easily browse between markers (like sound recordings).

As a noise monitoring platform, the Type 2250 instrument allows different combinations of application software modules to be selected. Additional applications such as Frequency Analysis (BZ7223), Sound Recording (BZ7226) and Logging (BZ7224) software can be purchased when needed and are delivered as easily installed licences. In this way a customer's investment in the Type 2250 platform is securely protected and when their measurement and analysis requirements grow then the Type 2250 can readily accommodate them. Brüel & Kjær is committed to maintaining an ever-growing range of applications on this platform."

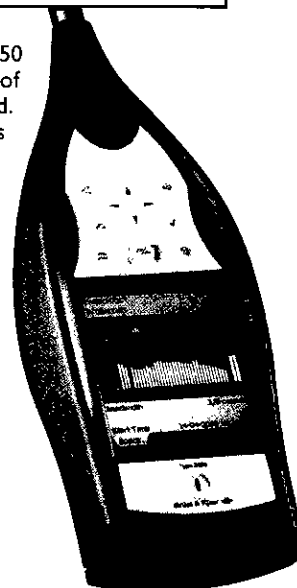
For further information contact

Rebecca McCullough, Brüel & Kjær UK Ltd,

Telephone: 01438739000 Fax: 01438739099

E-mail: ukinfo@bksv.com

Web site: www.bksv.com



Committee Meetings 2006

DAY	DATE	TIME	MEETING
Thursday	12 January	10.00	Meetings
Thursday	26 January	10.30	Diploma Tutors and Examiners
Thursday	26 January	1.30	Education
Thursday	2 February	10.30	Membership
Thursday	16 February	10.30	Publications
Thursday	9 March	10.30	Engineering Division
Thursday	16 March	11.00	Medals & Awards
Thursday	16 March	1.30	Executive
Thursday	23 March	10.30	Diploma Examiners
Thursday	30 March	11.30	Council
Thursday	6 April	10.00	Meetings
Thursday	27 April	11.00	Research Co-ordination
Tuesday	9 May	10.30	CCWPNA Examiners
Tuesday	9 May	1.30	CCWPNA Committee
Thursday	11 May	10.30	Membership
Thursday	25 May	10.30	Publications
	TBA	TBA	Annual General Meeting**
Thursday	8 June	11.00	Executive
Tuesday	13 June	10.30	CMOHAV Examiners
Tuesday	13 June	1.30	CMOHAV Committee
Tuesday	20 June	10.30	CCENM Examiners
Tuesday	20 June	1.30	CCENM Committee
Thursday	22 June	11.30	Council
Thursday	29 June	10.30	Distance Learning Tutors WG
Thursday	29 June	1.30	Education
Thursday	6 July	10.30	Engineering Division
Tuesday	11 July	10.30	ASBA Examiners
Tuesday	11 July	1.30	ASBA Committee
Tuesday	8 August	10.30	Diploma Moderators Meeting
Thursday	7 September	10.30	Membership
Thursday	14 September	11.00	Medals & Awards
Thursday	14 September	1.30	Executive
Thursday	28 September	11.30	Council
Thursday	5 October	10.30	Diploma Tutors and Examiners
Thursday	5 October	1.30	Education
Thursday	12 October	10.30	Engineering Division
Thursday	19 October	10.30	Publications
Thursday	2 November	11.00	Research Co-ordination
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Tuesday	7 November	1.30	CCENM Committee
Thursday	9 November	10.30	Membership
Tuesday	14 November	10.30	ASBA Examiners
Tuesday	14 November	1.30	ASBA Committee
Thursday	16 November	10.00	Meetings
Thursday	23 November	11.00	Executive
Tuesday	5 December	10.30	CMOHAV Examiners
Tuesday	5 December	1.30	CMOHAV Committee
Thursday	7 December	11.30	Council
Tuesday	12 December	10.30	CCWPNA Examiners
Tuesday	12 December	1.30	CCWPNA Committee

** Subject to finalisation of dates and venue

Light refreshments will be served after or before all meetings.

In order to facilitate the catering arrangements it would be appreciated if those members unable to attend meetings would send apologies at least 24 hours before the meeting.

Conferences & Meetings

Diary 2006

25 January 2006

Building Acoustics Group

Auralisation: Hearing is Believing - London

3-4 April 2006

Spring Conference: Futures in Acoustics

Today's Research - Tomorrow's Careers - Southampton

5-7 May 2006

The Sixth International Conference on

Auditorium Acoustics - Copenhagen, Denmark

17 May 2006

Measurement and Instrumentation Group

HARMful - judge for yourself! - London

11-12 September 2006

Underwater Acoustics Group

International Conference on Synthetic Aperture Sonar and Synthetic Aperture Radar - Lerici, Italy

10-12 April 2007

Underwater Acoustics Group

4th International Conference on Bioacoustics - Loughborough

Further details can be obtained from

Linda Canty at the Institute of Acoustics

Tel.: **01727 848195**

or on the IOA website: www.ioa.org.uk

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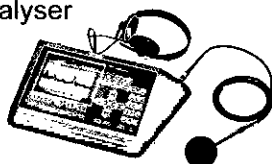


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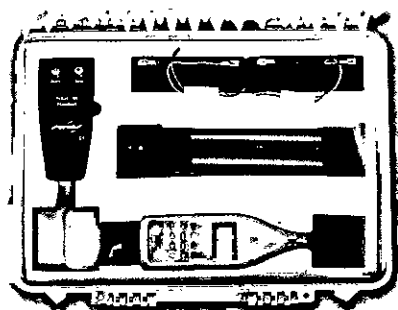
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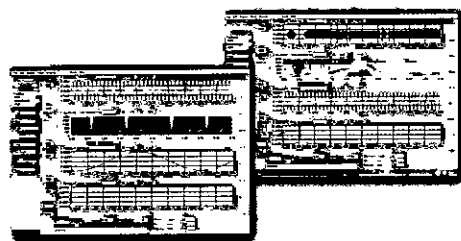
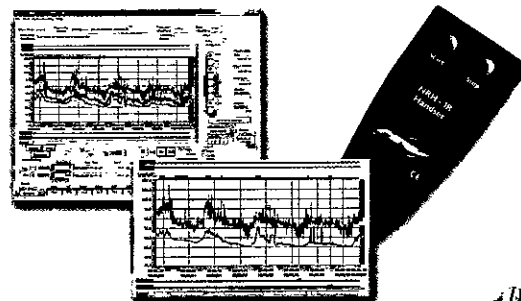
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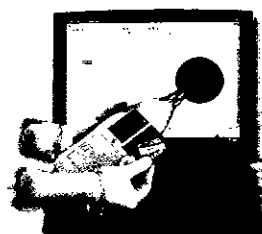
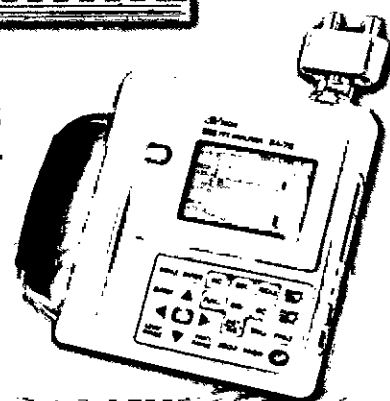


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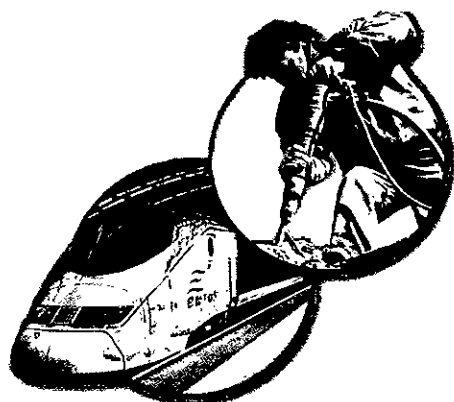
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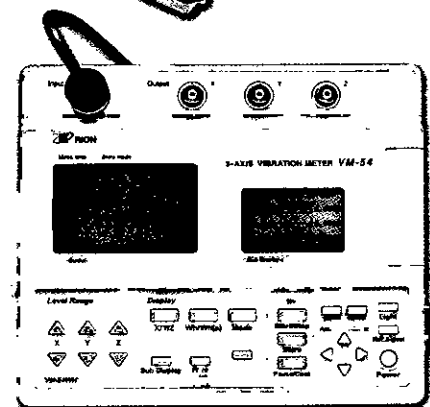
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